

Generative Video Art

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1 Abstract

Generative art is historically and widely used for the production of abstract images and animations, each frame corresponding to a generation or iteration of the generative system, which runs within the aesthetic boundaries defined by its author. But rather than being limited to image or sound synthesis, generative systems can also manipulate video samples and still images from external sources, and include vectors that can be mapped to the concepts of shot, sequence, rhythm and montage. Furthermore, generative systems need not be limited to the visual plane and can also render audio, either through sound synthesis or by manipulating sound samples. And in this case, since the output is a constant and uninterrupted audio-visual stream, is it not possible to speak of generative video art, as it becomes indistinguishable from its modern-day video art digital counterparts? Within this perspective, this article traces back the historical roots of generative video art, and proposes a theoretical model for generative video art systems, as a creative intersection of two artistic genres, often seen as disjoint.

2 Keywords:

Cinematic art, Video art, Generative art, Autonomous systems

3 Introduction

Before the advent of video art, avant-garde film – or abstract film – was mostly regarded as a spin-off of visual art movements like Cubism, Suprematism, Constructivism, Dadaism or Surrealism (Weibel 2003:110). Nevertheless, early experimental works dating from as far back as the 1910s, as those by Arnaldo Ginna and Bruno Corra, deserve credit in video art history. What is even more striking is that under the influence of Italian and Russian Futurism, experimental pieces by Hans Richter and László Moholy-Nagy already evidence the use of a structuring device, later recognised as a key characteristic of generative art systems (Veiga 2017b) and also used for image production and montage techniques (Rees 1999:27).

To further reinforce this early ancestry, the Futurist Cinema manifesto posited that cinema should detach itself from reality and from photography, from the graceful and solemn to become anti-graceful, deforming, impressionistic, synthetic, dynamic, free (Marinetti et al 1916; Rees 1999:28), all of which came to be trademarks of video art.

Still, video art, as a new branch of art, only assumed its status in the 1960s, at a time when new image recording instruments and technologies migrated from the corporate world to the public. If it can be defined from the technological point of view as an art form that uses video technology – both analogue and digital – video art also introduced counterculture aesthetics, created new concepts and forms that provoked displacements and deconstructions in the ways of relating to moving images. Although contemporary with early experiments in computer art and generative art, video art was less focused on the technological exploration, and more intent on the subversion of the conventional uses of television and film for the masses. Video art “was Paik’s attack on the physical interface of a commercial moving image – his first show consisted of televisions with magnets attached to them, and TV monitors ripped out of their enclosures” (Manovich 2006).

If Paik’s work was mostly produced by hacking the inner workings of video technologies, through hardware manipulation, its present-day echo can be found in generative video artworks, which now hack video streams from a software perspective.

Metz and Guzzetti (1976) posit one formal – and very relevant – distinction between video art and classic cinematic precepts: they characterize classic cinema as being based upon a narrative form and a reality effect, as opposed to an oneiric construct, which is the territory for video art to thrive, where time is disconnected from physical reality. Their stance on experimental film is rather critical, but stresses the absence of a linear narrative – or, as they call it, intelligibility:

those avant-garde or experimental films which, as the enlightened audience knows, it is appropriate at once to understand and not to understand (...) These films, whose objective social function is to answer the naively puzzled wish of certain intellectuals for nonnaivete, have integrated within their institutional regimen of intelligibility a certain dose of elegant and coded unintelligibility, in such a way that their very unintelligibility is in return intelligible. (Metz and Guzzetti 1976:88)

Whereas traditional film delivers a closed universe to the audience, video art triggers sensations and stimulates the imagination. Today video art is a discipline that reconciles different artistic fields, such as the visual arts, music, literature, cinema, dance, and theatre, extracting concepts and methods from different artistic movements, theories, and technological advances (Meigh-Andrews 2013), and appears to directly inherit the Futurists’ characterization. Video art embodies a social and cultural awareness and critique, both in terms of content and of representation, but also an aspect of plurality and the status of art-differently (Hayden 2015:186). In current video art practices, technologies, mediums, media, and genres have converged or become blurred. Moving images can now be recorded on film, on memory cards or smartphones, they can be edited in computers and tablets, projected online or at home, and all at a fraction of the cost when compared with earlier technological equipment used for the same tasks.

The idea of using video as part of a closed system through a feedback loop was already common to several artists during the 1970s, and this approach was actually in line with the rise of systems theory and computer-based art, at a time when the concept of participatory art paved the way to that of interactive art (Graham 1979).

We have gone beyond the image, to a nameless mixture, a discourse-image, if you like, or a sound-image (“Son-Image,” Godard calls it), whose first side is occupied by

television and second side by the computer, in our all-purpose machine society. (Bellour 1996:199)

Tracing generative video art's lineage through video art's distinct studies, contexts and theoretical propositions is an intricate task: electronic TV (Paik et al 2004); expanded cinema, intermedia and videotronics (Youngblood 1970); abstract film (Le Grice 1977); calculated cinema (Bonet 2007); experimental cinema (Le Grice 2002); artists' video, experimental video, new television and guerilla TV (Meigh-Andrews 2013); generative cinema (Lioret 2010); video installations, TV art and projected art (Hayden 2015); algorithmic editing (Enns 2019) are all designations – among many more, undoubtedly – that reflect not just a diverse range of art movements and activism, but also their contemporary cultural contexts and technological developments. Generative art, on the other hand, has ensured a somewhat *well-behaved lineage*, even though a proliferation of designations can also be found: computer art, process art, evolutionary art, genetic algorithms, among others, which are thoroughly dissected and historically discussed by Galanter (2016).

4 Roots

Among the many influential artists and theoreticians that could be summoned into tracing generative video art's lineage, I chose to only highlight a selected few in the following paragraphs, as they represent periods, trends, art movements, or a specific use of technological tools and media.



Fig. 1 Film poster for the première of *Vita Futurista* (Wikimedia Commons)

As Bonet suggests (2007) the first point of confluence between filmmakers and computers constitute, in some ways, the two greatest poles of reference in 20th century cultural history. For him both poles, at the beginning and end of that same century, encouraged the idea of a convergence between art, science, and technology. But video art was born from the need to critique a commoditized culture through its mass-produced technological pinnacle, therefore I posit yet another vector of convergence: society. Video art and generative video art both share this DNA of socio-cultural critique and intervention.

Bonet places the origin of calculated cinema as early as 1916, with the experiments of futurist artists Arnaldo Ginna and Bruno Corra in conceiving the film *Vita Futurista* (figure 1) in autonomous episodes or sketches.

In the late 1940s John Whitney and his brother James won the prize for best sound at the Brussels Film Festival with *Five Abstract Film Exercises*¹. They called their works *audio-visual-music* and their goal was to create films from pure light, by acting directly on the film by means of cutout shapes, instead of capturing images of objects in the world (Patterson 2009:39).

Nam June Paik and Wolf Vostell, two artists linked to the Fluxus movement, first exhibited their innovative artworks in 1963, thus establishing the commonly accepted birth date of this art form. Video art has assumed different formats, such as installations exhibited in galleries or museums, screened videos or performances that incorporate television sets, video monitors and projections, displaying moving images and live or recorded sounds.

Around the same time as Paik and Vostell's works were exhibited, the term *generative art* made its first appearance with Georg Nees' *Generative Computergraphik* exhibitions in 1965, both solo and with Frieder Nake.

As Constructivism and Futurism attempted to invoke the possibility of a worldview based on industrial processes, so generative art presents us with a *Weltanschauung* of computation. Forms produced by generative systems often take on a complex nature, exploiting principles of emergence to produce structures that could not be made by human hands. Inspiration taken from processes found in nature is common, with the tension between organic and mechanical forms ever-present. A common challenge in computational aesthetics is the simulation of organic behaviour and spontaneous irregularities, phenomena that appear in nature without prompting but which can only be replicated by computers with the explicit encoding of such behaviour (Watz 2010:1).

In 1967, A. Michael Noll (1967) brought up the connection between computers and the visual arts and the benefits of the artistic exploration of new technologies, such as the reduction of labour intensive and repetitive tasks that required precision. Noll and his peers published hypotheses and models for automating the creation of optical, geometric, kinetic, dynamic, psychedelic, and stereoscopic works of art. Limited by the capabilities of early computers for processing images and sound, as well as contemporary trends in visual arts – abstractionism, cubism, and constructivism – these new approaches were mostly oriented towards concept and procedure, using a rather minimalist approach.

¹ The film can be viewed here: <https://www.youtube.com/watch?v=JdCjwS1OxBU>

Nowadays using digital computers to tackle generative systems and their iterative nature ensures that several complex operations can take place almost instantaneously, not just in numerical terms, but more specifically in terms of media manipulation, including still and moving image files, sound files, as well as image and sound synthesis, which would otherwise be extremely hard – if not impossible – to accomplish in an analogue environment. And current computers also provide practical solutions for stochastic generative systems, through the introduction of chance (even though I prefer the expression “controlled randomness”).

Moles posits the concept of constraint as a revolt against (pure) chance:

There is no art without constraint. To say that music is an art is to say that it obeys rules. Pure chance represents total liberty, and the word construct means precisely to revolt against chance. An art is exactly defined by the set of rules it follows. (Moles 1966:102)

But what better revolt than that of appropriation, embracing chance through constraints? Among the many definitions of generative art (Veiga 2017b) a common trait is the existence of an algorithmic system with some degree of autonomy, iteratively combining structure with controlled randomness. And this set of rules is indeed what defines generative art. The system’s output is a complex flow of graphics, text, audio, all of which can be synthesised or manipulated and recombined, either independently or creating cross-media patterns. Thus, a seemingly infinite and iterative sequence of states or combinations is achieved, within a specific aesthetic boundary and intent defined by the artist/programmer (Dorin 2013).

James Whitney’s seminal work *Lapis*², from 1966, could be posited as the first generative video artwork, as it was produced with the help of a (analogue) computer, built from surplus World War II anti-aircraft guidance hardware:

He [John Whitney] transformed this military-spec surplus into a machine for creating experimental animation – literally and metaphorically retooling a device that had itself served to remake human vision for modern war. A twin of this machine would enable John’s brother James to create the 1966 film *Lapis*, a work P. Adams Sitney would describe as “the most elaborate example of a mandala in cinema.” (Patterson 2009:37)

Lapis, like most early generative art, was an abstract work, consisting entirely of hundreds of moving points of light, which are given a radiating structure, similar to that of a mandala. *Lapis*, which is Latin for *stone*, winks at the alchemical transformation of the philosopher’s stone, turning light and chaos into shape and contrast.

This approach embodied the attitude of the *structural* or *materialist* filmmaker, who took pride in exhibiting not just the film, but the whole apparatus of production and representation. This went against the conventions of cinema, which sought to conceal the processes to focus mainly on the end result. The structural/materialist approach was intent on engaging the audience at all levels of the creation and production processes, much like a scientific researcher and experimenter – a maker –, which confronted, to a certain extent, the ideal of the artist as a transcendent and illuminated individual.

² For an interview conducted by David Em with John Whitney about his creation processes and work, which also includes excerpts of *Lapis*, see <https://www.youtube.com/watch?v=cP5Mj6ZvZJc>

Since those early days several other examples have evolved, dealing with the applicability of generative systems to non-abstract forms, such as L-systems use in 3D software for generating plants (Parish and Müller 2001; McCormak 2003), generative music (Eno 1975; Rodrigues et al 2016; Dean 2017) and generative literature (Balpe 2005; Montfort 2013), all of which seek not just to exhibit the artwork as an outcome of a process, but also to detail and discuss the process itself.

From a visual stance, if the generative system's vocabulary consists of lines, geometric figures and patterns, the rapid sequencing of its states – or generations – will deliver an animation. However, if instead of being limited to lines and geometric primitives the system also manipulates images and image sequences, then the output becomes almost indistinguishable from (digital) video art, except for its potentially infinite duration and constant variation.

The recent rise in popularity (or at least widespread visibility) of generative video artworks, can be attributed in part to the COVID-19 pandemic, since their online exhibition – as a video file, resulting from a screen capture or automatic frame calculation and sequencing – was facilitated in the categories of *Video Art*, *Experimental Cinema* and *Expanded Cinema*, in a range of events, from festivals to galleries, from contemporary urban architecture with giant public screens to trade shows and conference displays, from entertainment and consumerism centres to multimedia music shows and VJ performances (Manovich 2006). All these events embraced the virtual form on the Internet in an unprecedented way, in complement to previous physical formats and venues.



Fig. 2 Still image from *Alchimia* (author)

The immense poetic and expressive potentials of film have been barely realized within the cinematic cultural legacy, mainly due to industrialization, commercialization, politicization, and consequent adherence to the pop-cultural paradigms. Unrestrained by commercial imperatives, motivated by unconventional views of film, animation, and art in general, generative artists have started to engage

these potentials playfully and efficiently, with explicit or implicit critique of cinema in a broader cultural, economic, and political context. (Grba 2017:384)

And some of those artists have also been embracing non-abstract (even if surreal) aesthetics, often incorporating sound into their artworks, such as Brian Eno's *77 Million Paintings* (Marshall and Loydell 2017), Jim Bizzocchi's *Re:Cycle* (Bizzocchi 2011), Doug Goodwin's *Mersenne Devil Twister* (Goodwin 2011); Rachele Riley's *The Evolution of Silence (V2)* (Riley 2014), or Pedro Veiga's *Alchimia* (Veiga 2017a) – figure 2. In these works, the concepts of cinematic shot, sequence, sound sample, and timed montage replace – or coexist with – the concepts of point, line, and colour in the generative systems' grammars, as atoms of their alphabet.

Generative video art may thus be perceived as both the offspring of abstract generative art with analogue video art, as well as a specialization of generative cinema. Much like video art, generative cinema in digital art became more accessible – and therefore popular – with the democratization of the technologies for digital video recording and editing. The ensuing development of the area, however, was fostered not just by technical aspects, such as the development of software and hardware for manipulating large numbers of equally large multimedia files and complex databases, but also by methodological and conceptual aspects, going beyond the limitations of image and sound synthesis, embracing different poetics, much like video art did in respect to film and cinema.

Through generative video art, artists gain new insights and are able to explore conceptual, formal, technical, expressive and communicational elements of generative systems, film and animation, enhanced through experimentation and stochastic factors – easily achievable though the use of computational systems. Furthermore, the algorithmic nature of generative artworks along with the non-destructive characteristics of digital art – which allow for the adaptation and evolution of artworks, without the destruction of the previous versions – ensures that they can be repurposed and redeveloped into new projects with potentially distinct intentions, identities, impacts, and outcomes (Veiga 2019), effectively turning them into generative frameworks.

This article thus posits that generative video art has specialised characteristics, inherited from film, generative art and cinema, whose combination determines a specific and distinct identity. Over the next sections these characteristics will be analysed and discussed.

5 Process

When designing a generative video art project, the artist will be faced with a set of decisions, ranging from intention to aesthetics, from programming choices to audience impact. Since generative processes are closely linked to representations of natural phenomena, including evolutionary organisms and artificial life models, the use of biological metaphors is also popular (Dorin and McCormack 2001).

The terms genotype and phenotype are used to represent two distinct stages of the generative process. In biology the genotype is a collection of DNA, whereas the phenotype is the collection of the resulting features and characteristics the DNA determines on the organism. In digital computer systems, the genotype is the data that is used as input into an algorithm, which then produces the phenotype as a calculated result.

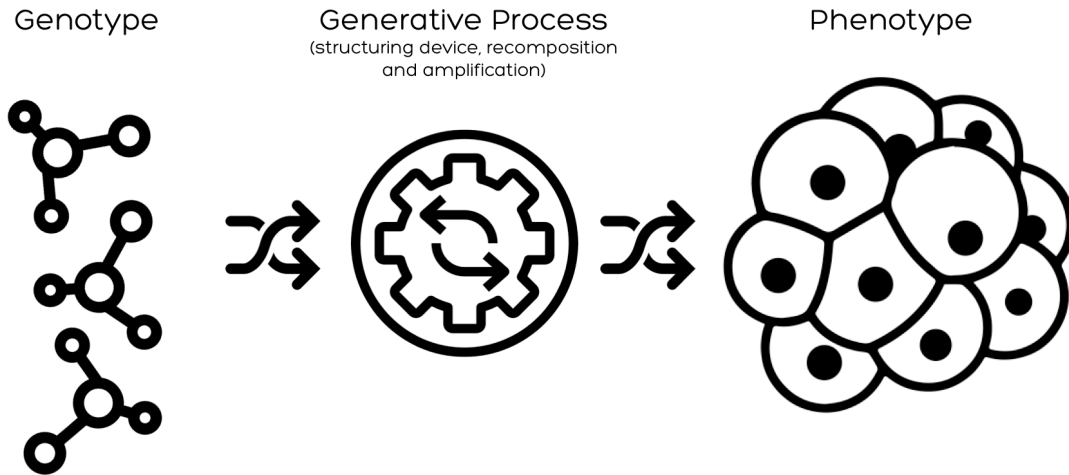


Fig. 3 The genotype and phenotype in generative art (author)

The genetic/generative system evolves through the introduction of changes, either deliberate or stochastic to the genotype selection, discarding those combinations that do not fit within the artist's vision, and further breeding genotypes that do. Thus, the enactment of the generative system delivers a phenotype as its output, as one instance of the artwork. This also implies that a finite genotype can originate an exponentially larger number of phenotypes, as is usually the case with generative artworks, not only due to the different combinations of genotypes, but also due to the introduction of stochastic and random elements. Figure 3 illustrates these stages.

Whereas in previous work it was proposed that the creative process behind generative art systems could be decomposed into three steps (Veiga 2017b), the present article posits an extra step, which tackles in detail the figurative dimension, and can also be a generative process in itself. It is thus the first step to be considered.

5.1 Vocabulary Identification

At the genotype identification stage the artist will determine which symbols will be involved in the artistic creation. Usually L-systems, which can be found at the core of most generative art systems, are built from grammars, comprising a vocabulary (made of units or symbols), axioms (combinations of the vocabulary units) and rules (which determine the evolution of each vocabulary unit or their combinations). Each abstract symbol can then be assigned a concrete conversion or interpretation: into spatial positioning, choice of geometric shape, translation, rotation, scale, or even musical note pitch or duration. But this list is as long as the full range of objects that can be manipulated by the programming language, including all primitives that can be used from within the code (to obtain image and sound synthesis, for example) to the manipulation of external files containing video snippets, images (both static and animated), sound samples, text files or any other relevant file types or databases.

Let us then use the word *vocabulary* to designate the set of all possible symbol replacements we can consider in the creative process of a specific generative artwork. This choice of vocabulary is also the first step into defining a subject or theme (if applicable) and also a first step toward the definition of the artwork's aesthetic boundaries.

Once the vocabulary is chosen the artist will engage in a process of deconstruction, decomposing each collected element into their simplest – one would dare suggest atomic – form, so that these atoms can then be manipulated by the structuring device.

Among the many experimental results to which the informational theory of perception makes it possible to attain, the conceptions developed here suggest an experimental aesthetic methodology. Thus, one of the most general methods of aesthetic discovery consists, on the basis of the materiality of the work of art, in progressively destroying it by known quantities, and in following the variations of aesthetic sensations, value, of the knowledge of the work as a function of this destruction. This is a method of concomitant variations. The used method of destruction will depend on 1) the nature of the artistic message (audio, visual, etc.), 2) the a priori knowledge that one may already have on it (form, subject, etc.), 3) factors that we seek to highlight (regularity, originality, semantics, etc.). (Moles 1957:239)

However, vocabulary units may be derived from other simple units. When Paik (1976) translated the metrics of space (the frame) into the metrics of time, which he manipulated in order to produce his video installations, he laid the foundations for the current use of temporal (rather than spatial/frame) units of calculation, most particularly in digital media, since clock synchronism is achievable in most programming languages. “These experiments with temporal and iterative strategies set out to expand the material space of the cinematic experience” (Legget 2007:123). Temporal units and timed iterations may thus be used to describe different types of audio-visual sequences, which will in turn be treated as vocabulary units: frames, flicker forms, loops, and cycles.

The term frame has come to designate the shortest temporal unit present in both film and also generative systems, and the concept of *frame rate* (the number of frames that are shown in one second) is implemented in most programming languages currently used for generative art. Therefore, the frame can be defined in terms of a fraction of a second, the most popular values being directly inherited from video and television: 60, 30, 26 or 25 frames per second.

Flicker forms consist in the rapid flashing of either structured or unstructured frames and are “the vehicle for the attainment of subtle distinctions of cinematic stasis in the midst of extreme speed which can be presented so as to generate both psychological and apperceptive reactions in its spectators” (Sitney 1979:288). The most common and familiar flicker form is the strobe light, closely followed by short animated GIFs, endlessly repeating the same (structured) content. But if the artists so desire, they can introduce considerable randomness into the content, thus making it vary from total structure to (almost) total chaos, and yet retaining the flicker form by obeying the time constraint.

Loops essentially differ from flicker forms in terms of their duration. Whereas the flicker form is characterised by rapid flashing content, the loop may last for several seconds and even minutes. Loops became one of the most prevalent modes of presentation in video art (Abramovic 2002:14) but in more recent years animated NFTs and GIFs have also contributed to the loop’s stable (growing?) popularity.

From an artistic and cognitive perspective, the loop allows for a temporal processing that can lengthen the experience by requiring the observer to attend to and process time-related information, to observe more carefully what was irrelevant beforehand, to deepen their understanding and immersion. In other words, the potentially endless structural repetition

accidents tell of it often) ... or, as in the example of Proust, one can brood over a brief childhood experience practically all of one's life in the isolation of a cork-lined room. That means, certain input-time can be extended or compressed in output-time at will... and this metamorphosis (not only in quantity, but also in quality) is the very function of our brain which is, in computer terms, the central processing unit itself. The painstaking process of editing is nothing but the simulation of this brain function (Paik 1976:98).

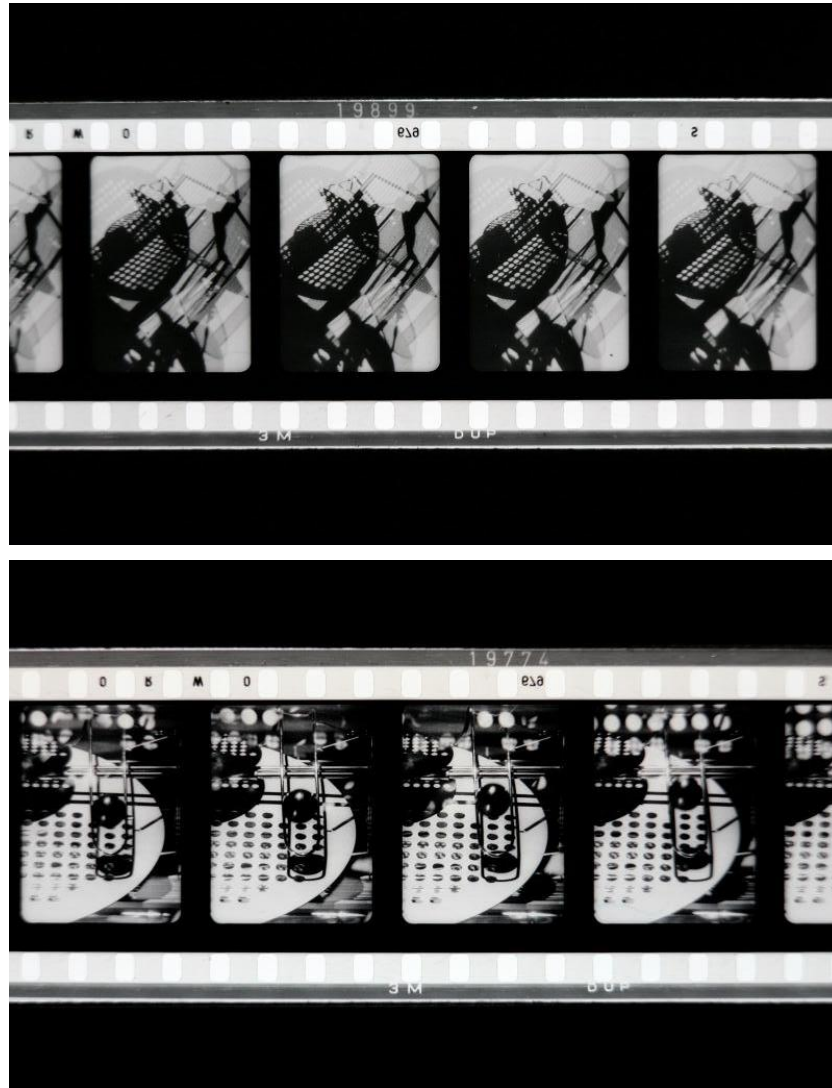


Fig. 5 and 6 László Moholy-Nagy's Lichtspiel: schwarz, weiss, grau (Centre Pompidou, public domain)

Going back to the 1920s, at a time when avant-garde cinema was heavily influenced by soviet filmmakers, such as Eisenstein and Vertov, Hans Richter produced several interesting film works, which can be used to exemplify types of montage that are now associated with both Russian montage film theory and the video art form. His works illustrate not just the rhythmic synchronization achieved between abstract animations and sound, but also the comparison between Eisenstein's concepts on montage to Japanese Haiku poetry, where the gaps in meaning create the space for imagination to fulfill (Eisenstein 1949:90-103). Richter's animations can still be appreciated in digital transcriptions, and *Rhythmus 23*³

³ <https://youtu.be/CMd2J9teidY>

(from 1923) or *Filmstudie*⁴ (from 1926) are remarkable – and very early – precursors of video art, combining direct frame painting with cinematic shots. In these examples the structuring device is the set of rules followed by the artist in determining the origin, order, and duration of the different sequences. Hans Richter characterised his artworks in terms of the organisation of abstract forms, claiming it was founded on “a universal language, which is what abstract art should be about” (Foster 1998:172).

A few years later, László Moholy-Nagy’s *Lichtspiel: schwarz, weiss, grau* – figures 5 and 6 – created in 1930, also provides an excellent example of a machinic (non-computerized) structuring device in action. Produced with the help of a mobile sculpture he designed and called *light space modulator*⁵, the film essentially contains fixed camera sequences of the device in action, depicting its abilities to modulate light (in black, white, and grey renderings).

In 1949 the Whitney brothers produced an experiment in synthetic sound, by inscribing it directly on film, through the use of a structuring device: pendulums of differing lengths were fit with weights and then attached by wire to the film strip. Their movements were used to directly etch lines on the strip, creating patterns that could generate sound through the projector, thus effectively transforming motion into sound (Patterson 2009:39-40).

Directors such as Sergei Eisenstein and Dziga Vertov laid the foundations of five different types of montage: metric, rhythmic, tonal, overtonal and intellectual (Salvaggio 1979). However, the algorithmic and calculated nature of generative video art determines that the focus will fall mainly on the first two: metric and rhythmic montage – despite the fact that exercises in addressing tonal and overtonal montage types have also been addressed by Manovich’s *soft cinema* (2002). Vertov describes editing as “the combining (addition, subtraction, multiplication, division, and factoring out) of related pieces” and then describes one stage of editing as a “numerical calculation of the montage groupings” (Vertov 1984:90). He then proceeds explaining how an editing table should have “definite calculations, similar to systems of musical notation, as well as studies in rhythm, ‘intervals,’ etc.” (Vertov 1984:100) – figure 7.

As mentioned, in the current context, metric and rhythmic are the most relevant montage types inherited from calculated cinema, since they imply the consistent application of an algorithm (or automation) to a human activity: that of editing film according to specific and objective rules.

Metric montage is based on the absolute length of shots, regardless of their content, aiming for a constant cadence, often synchronized with music – which is something a digital computational system does with utmost precision and efficiency. Rhythmic montage, on the other hand, seeks an editorial and compositional relationship in which the sense of motion within each sequence is as important as its length, thus reinforcing one another (Eisenstein 1949). Determining rhythm and intensity, translated into acoustic pattern detection, or the amount of variation in image and sound sequences is something that computers can also very easily perform, therefore allowing for the automation of those processes. This allows not just for rhythm (duration) and intensity (amount of variation) to be rules-driven,

⁴ <https://youtu.be/ZXrjrr6ifME>

⁵ <https://youtu.be/nVnF9A3azSA>

combination of chaos and order is yet another characteristic that draws structural film closer to generative art, adding to the four properties that Sitney uses to characterize structural film:

- the use of a fixed camera position – or its digital conceptual equivalent;
- the use of flicker forms – also known as *strobing*;
- the use of loops;
- and rephotography from the screen, which could be described as the recursive and generative act of capturing a previously generated frame (or sequence) and using it as part of the vocabulary for generating subsequent frames (or sequences).

To finalize the triad of relevant foundations to the field, now is the time to introduce *soft cinema*. Manovich (2002) posits the use of an algorithm at the heart of what they describe as *soft cinema*: whereas *hard* cinema is characterised by story-telling elements, scripting, shooting, and editing guidelines, *soft* cinema is the result of algorithmically sequencing audio-visual units from a database, often incorporating controlled randomness in the selection mechanisms. The algorithm can be used to create the vocabulary – or the database – since “once digitized, the data has to be cleaned up, organized, and indexed. The computer age brought with it a new cultural algorithm: reality → media → data → database” (Manovich 2001:224). And the algorithm is then reversed, as the generative video artist uses it to create the artwork: database → data → media → reality.

The adjustable combinations and weightings allow generator users to create films edited according to formal criteria similar to those of classical montage, but without regard for the development of a narrative storyline. In this sense, such works are closer to a relational database than to an edited film. (Manovich 2002:13)

In soft cinema the screen can be simultaneously occupied by a mosaic of images, not just one, and their succession is not necessarily fixed. Each new image may be drastically different from previous ones, depending on the use of controlled randomness in the selection of the database units, and the database itself.

Generative video art inherits, thus, characteristics of calculated cinema, structural film, and soft cinema. All these characteristics imply the existence of rules, which are at the heart of generative art. These rules allow for systemic autonomy, relative to the conscious decisions of the human artist – a significant phenomenological property of generative artworks. The system, once started, will continue to evolve within its defined boundaries, allowing for unexpected combinations or results, through the introduction of controlled randomness.

The centre of the spectrum that ranges between complete chaos and simplistic order is much richer than either of the extremes. A possible explanation of this property, posited by Davis (1997), is that the human mind finds appealing those visual and auditory event combinations where properties of hierarchical complexity and subtle disorder are present, and that combinations of these loosely defined properties tend to be maximized at the centre of this spectrum. This is what Galanter (2016) describes as a complex system, one that is at the apogee of the complexity curve, interweaving order and chaos through rules and constraints, in an aesthetically pleasing way.

5.3 Recomposition and Amplification

Once the structuring device is defined, cognitive extensions are developed through correlations between different media types, involving recursive structures and patterns. This is the stage where the recomposition of the (previously decomposed) atomic elements takes place.

The system of generative aesthetics aims at a numerical and operational description of characteristics of aesthetic structures (which can be realized in a number of material elements) which will, as abstract schemes, fall into the three categories of the formation principle, distribution principle and set principle. These can be manipulated and applied to an unordered set of elements, so as to produce what we perceive macro aesthetically as complex and orderly arrangements, and micro aesthetically as redundancies and information. (Bense 1971:207)

Through the use of controlled randomness, each time the system runs it delivers a (potentially) heterogeneous realm of different outcomes, instances of the phenotype, with different factors of unpredictability. As these chance procedures induce unexpected forms despite coming from a precise mathematical procedure, the artworks maintain unexpected elements.

The combination of vocabulary atoms extracted from the database can also be dynamically rephotographed, which means that the result of their combination is inserted into the database, thus becoming a new vocabulary atom. As the vocabulary evolves, so does the artwork, and so the next iterations/generations will be created over an increasingly larger vocabulary. The term *amplification* is also used to describe this stage, as the amount of generated information will largely exceed the initial vocabulary. But amplification may also be a result of errors in the code, as they often produce unexpected results, such as novel visuals or combinations. Through the added layer of mystification (as the artist will not expect them) these glitches contribute to the expansion of the otherwise planned artwork.

The core of this stage relies in the iterative identification of the most aesthetically pleasing or meaningful combinations of atomic elements, the creation of new complex vocabulary elements through repeated execution and observation. Adjustments are then – also iteratively – introduced in the structuring device to reflect these choices and observe the new outcomes they imply. This is how the aesthetic boundaries of the artwork are defined.

(...) another common feature of generative systems: the emergence of new properties that result from local interactions between individual components. These new properties are not specified in the genotype — they emerge via the generative process. (McCormack 2003:6)

Each newer generation – which can be a frame or a sequence – depends upon, or inherits, structural and compositional characteristics of the previous generation(s), but through the constrained unpredictability built into the structuring device, each time a complex generative artwork is executed, its outcome will be different.

Due to the fact that interference mechanisms can be built into the system, either derived from information gathered from the system execution itself, from human interaction or external sources, mapping these interferences to semantic options is another important step, as they can be used to influence the direction and evolution of the generative artwork.

In this way, sound, image, composition, or movement can be interpreted and manipulated during run-time.

[Concerning generative art] process (or structuring) and change (or transformation) are among its most definitive features, and that these features and the very term 'generative' imply dynamic development and motion. (Clauser 1988:117)

Once the artist is pleased with the recomposition and amplification mechanisms that were introduced into the structuring device, it is time to move on to the final stage.

5.4 Event Detection

In the fourth stage, the artist has already introduced adjustments to the system, both in terms of structuring device and amplification mechanisms, and is now concerned in identifying the more (aesthetically, meaningfully, or otherwise) relevant occurrences as the system runs. Drawing on the previously presented genotype/phenotype metaphor, the artist will now identify which element (or family of elements) of the phenotype will be selected for public exhibition.

Each execution is called *an event*, and the artist will probably disregard many events, through trial and error. But one of them will eventually be identified as a full-bodied artistic expression of the initial concept and aesthetics, like an epiphany:

I was also imposing a new and more restrictive requirement on my work, i.e. that the structuring process must generate a visual epiphany, or epiphanies, in the painting. As is well known, epiphany is used in the arts and literature to refer to sudden revelations or manifestations of meaning. Speculatively, in science, epiphany might be considered roughly analogous to the sudden emergence of a new and higher level of order through the self-organizing principles of dissipative structures, such as living matter (...). Also, conceptually, it is suggestive of a mutation. (Clauser 1988:120)

This epiphany (or epiphanies) will be registered through screen-recording mechanisms or by calculating each individual frame and then converted onto a video format, according to the exhibition requirements. As a video file, its essence will become potentially indistinguishable from other digital video art counterparts, produced by other (non-generative or computational) methods.

Rather than delivering one single, immutable video stream at each showing, a generative video art system may deliver a coherent family of instances or events, sharing common aesthetic traits, but distinct from one another.

Ultimately these instances also share another trait in common with early video art: impermanence. The potentially impermanent and ephemeral nature of video was at one moment considered a virtue by some artists who wished to avoid the influences and commercialism of the art market. For them, working live (or, as we might put it in terms of generative video art, in run time) could be regarded as an artistic statement, and such may still be the case with many VJs or live-cinema practitioners. This implies, however, that many relevant artworks are – and will be – lost, marginalized, or ignored, and other less relevant artworks deemed unworthy of preservation (Meigh-Andrews 2013).

These four development stages are illustrated in figure 8.

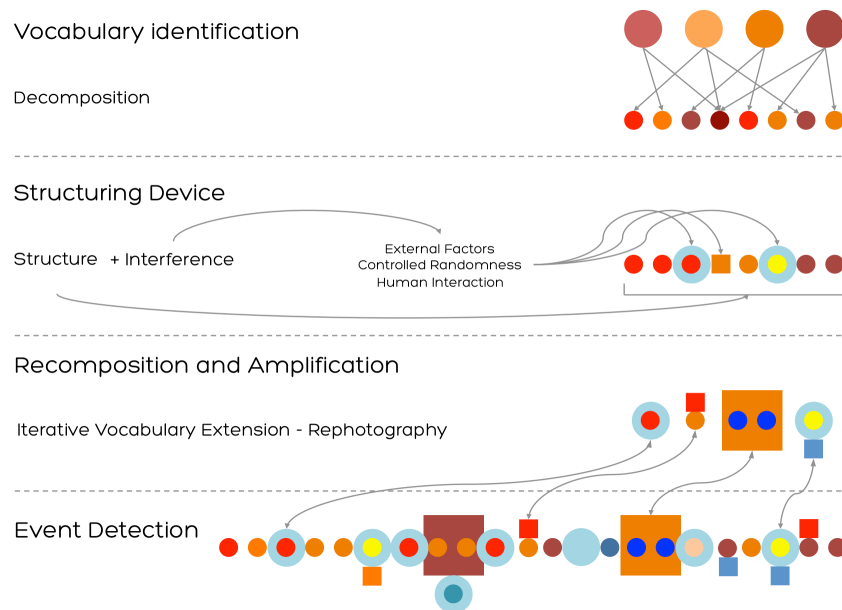


Fig. 8 The proposed four development stages of a generative video artwork (author)

6 Poetics

As was previously mentioned, generative video art inherits a rich historical background, not just in technical terms, but also in its aesthetics of displacement, deconstruction, and oneirism. Early video art pieces were mostly poetic works in which formal devices were symbolically used to establish complex interrelations between images. Generative video art works have embraced the use of formal devices to predefine the composition and structure of the artwork, defining its boundaries. All the instances (obtained during runtime) evolve within those boundaries, even before deciding what images and sounds populate which sequences. The poetics of generative video art are not just those of content: they are also those of form. They are organic, as one aspect influences the other, closely bound and evolving together.

The idea of “wholeness” is obviously not new, but recently it has taken on a meaning different than the accepted “organic unity” principle which Eisenstein stated so lucidly: “ ... in an organic work of art, elements that nourish the work as a whole pervade all the features composing this work.” A unified canon pierces not only the whole and each of its parts, but also each element that is called to participate in the work of composition. One and the same principle will feed any element, appearing in each in a qualitatively different form. Only in this case are we justified in considering a work of art organic. (Sharits 1972:27-28)

Fluxus is also a significant part of generative video art’s inheritance, and the following excerpts of Friedman’s Twelve Fluxus Ideas (2007) illustrate how (almost naturally) relevant they are in the present context:

Globalism: This is achieved through the encouragement of dialogue among like minds, regardless of nation, and that of unlike minds when social purposes are in tune. Fluxus posits globalism, democracy, and anti-elitism as intelligent premises for art, for culture and for long-term human survival. Generative video art seeks a universal language, one that

speaks of human emotions and aesthetics, of ideas and sensation, regardless of nation or spoken language, one that bares the artists and their technique, rather than idolise them.

Unity of art and life: Fluxus' conscious goal was to erase the boundaries between art and life, regarding both as parts of a unified field of reference, a single context. Generative video art embodies the very notion of an *organism*, one that evolves, generation after generation, thriving on the artist's vision. As it handles captured images of life itself, this unity exists in more than just the theoretical plane: it is a part of the artefact itself.

Intermedia: Even though we can still identify separate art forms and their media, intermedia seeks to point out that our time often calls for art concepts that draw on the roots of several media, growing into new hybrids. And generative video art is yet another hybrid, the result of the convergence of video and computers through digital technologies, tackling sampled and synthesized, still and animated images, sound, music, and text.

Experimentalism: Fluxus advocated for experimental research orientation, by trying out new – sometimes iconoclastic – approaches and assessing the results. Experiments that yield useful results cease being experiments and become results, exactly like the event detection stage posits, in the generative video art creative process.

Chance: Randomness is a tradition with a legacy going back to Duchamp, to Dada and to Cage. A new, uncontrolled variable is taken into consideration and changes the previously held worldview. It may stem from chance or be the result of signal interference, or even be the result of a sudden insight. When controlled randomness is incorporated in the artefact, it ceases to be random and becomes evolutionary. And again, controlled randomness is, as previously mentioned, one key characteristic of generative art, and of generative video art as well.

Playfulness: In the Dada tradition, humour is a key topic for Fluxus, but the concept of playfulness extends beyond humour: it refers to the play of ideas, of free experimentation, and free association, and the play of paradigm shifting, found in scientific experiments, as well as in pranks. Generative video art fully embraces these aspects, and adds one more: playfulness through interaction and participation, during runtime.

Simplicity: Another term for this concept is elegance, in the relationship between truth and beauty. Generative video art is usually complex, from a technological and aesthetic point of view, but it seeks elegance, just as much as Fluxus, and not just in terms of the impact achieved on the art audience, but also in the construction, in the elegance of the coding of the artefact itself.

Implicativeness: An ideal Fluxus work implies many more works, as could be expected from the advocated relationship with experimentalism and the scientific method. And the exact proposition holds true for generative video art: an artwork's algorithms may be adapted to newer versions of the same artwork or to a completely new project, in a non-destructive way.

Exemplativism: This is defined as the quality of a work that exemplifies the theory and meaning of its construction. Like so many generative video art projects, which are accompanied by scientific texts detailing their concept and implementation.

Specificity: The tendency of a work to be self-contained and to embody all its own parts. This idea is actually ambiguous, and Friedman acknowledges this fact by stating "this may

seem to contradict the philosophical ambiguity and radical transformation of Fluxus. Nevertheless, but it is a key element in Fluxus". There might be a divergence here, since generative video art thrives on the oneiric, on the ambiguous. However, from the artist's point of view there will always be a specific reason for creating the artwork and a specific intention for its exhibition.

Presence in time: The ephemeral quality is key to Fluxus performance works, but also because they embody a different sense of duration: musical compositions with inordinately extended durations or artworks that grow and evolve over equally long spans. Time is a central issue in Fluxus and so it is in generative video art, as was demonstrated by its roots in calculated cinema and its relationship to time-dependent vocabulary (flicker forms, loops, and cycles).

Musicality: This addresses the fact that many Fluxus works are designed as scores, as works that can be realized by artists other than the creator. Musicality is linked to experimentalism and the scientific method, as experiments are expected to be reproducible and deliver a similar outcome. A scientist must be able to reproduce the work of any other scientist for an experiment to remain valid. A generative video art system will deliver an instance of the artwork, even if it is executed in a different environment and by a different operator – as long as the experiment conditions are ensured. The code is the score.

The fact that these ideas so adequately fit generative video art, should cause no surprise, especially when dealing with a time-based art form that not only needs time to be fully appreciated, but also bends and manipulates time and its flow, that maps input-time to output-time, that delivers a *fluxus*, where experimentation and exploration play a crucial role.

All poetic language is the language of exploration. Since the beginning of bad writing, writers have used images as ornaments. The point of Imagisme is that it does not use images *as ornaments*. The image is itself the speech. The image is the word beyond formulated language. (Pound 1914)

Drawing on the correspondence exchanged between Marshall McLuhan and Ezra Pound about the written form and the image, one can now posit the applicability of key concepts, such as the *mosaic*, the *perceptions of simultaneities* and the *vortex* to generative video art, from a poetics stance.

For Pound (1914), an image is that which presents an intellectual and emotional complex in an instant of time. The image does not stand for an idea: it acts as a radiant node or cluster. In generative video art, the image may be deconstructed in the early stages (while defining the vocabulary atoms), only to be reconstructed, recomposed, reorganised, recombined. Thus, the image becomes a *vortex*, "from which, and through which, and into which, ideas are constantly rushing" (Pound 1914). Vorticism, as applied to the visual arts, is illustrated in figure 9, which seeks to instantaneously deliver such a complex construct.

Pound stressed the representation of energy, of mechanical efficiency, of concentrated power, and also justified vorticism as a legitimate expression of life. For him, vorticism brought a new arrangement of forms, and allowed for different and new ways of perceiving, representing, and understanding the changing reality (Macedo 2014:155).

Generative video art, as a time-based art form, not only embodies these concepts, but also adds a time-based vortex and a time-based mosaic to them, as each iteration produces a new vortex, a new mosaic, in rapid sequence.

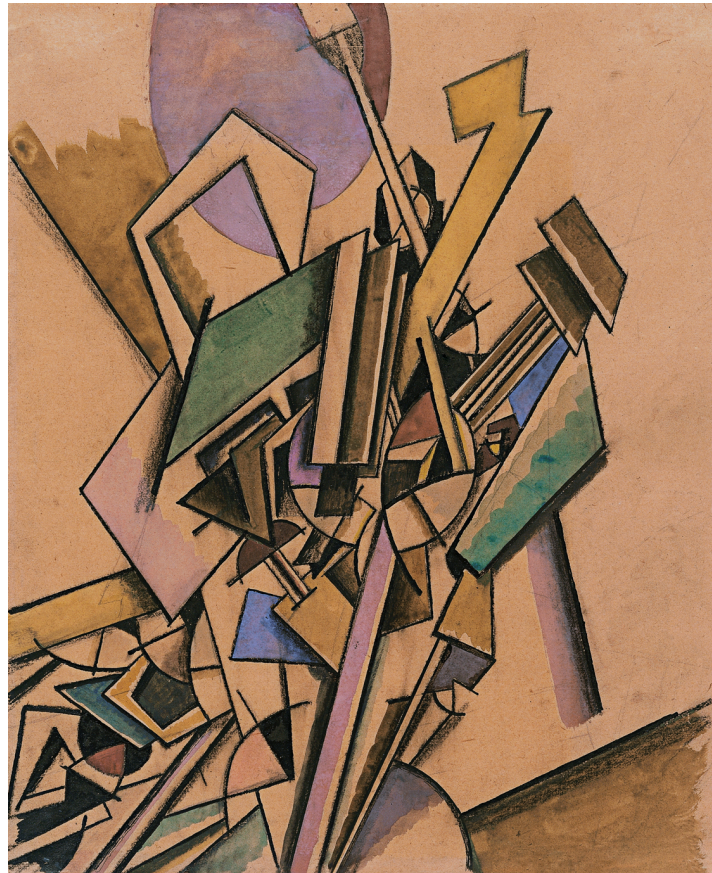


Fig. 9 Edward Wadsworth, Vorticist Study, 1914 (Wikimedia, public domain)

The expression “perceptions of simultaneities” is used by McLuhan (1988:193) in a letter to Ezra Pound, to characterize his work, *The Cantos*. McLuhan’s subsequent development of the *mosaic* theory is grounded in Pound’s *imagisme* and *vorticism*, and tackles non-linear thinking, *presentness*, and juxtaposition. For Lamberti (2012:32) “McLuhan uses his mosaic to question traditional ideas of knowledge and to move the reader from a linear (logical, ordered, exclusive) to an acoustic (non-logical, simultaneous, inclusive) perspective”.

This perspective is embraced by video art, and most particularly by generative video art, determined by the absence of a formal logical and linear narrative (replaced by sensations and evocations), by recomposing and recombining its vocabulary into simultaneous renderings of different sources, and by welcoming chance, interaction, and participation.

(...) the display joins the individual strands of film produced using the generator to form a kind of montage of simultaneity. This program divides the screen into individual segments and within each either a film or abstract animation is shown. The division is done by an algorithm, ensuring that the screen is harmoniously divided up. Thus, differences in size and positioning on the screen take into account the correspondence and relationships between the individual films. The same stage of processing that divides up the screen allocates soundtracks, a looped text and a voice-over channel. (Manovich 2002:13)

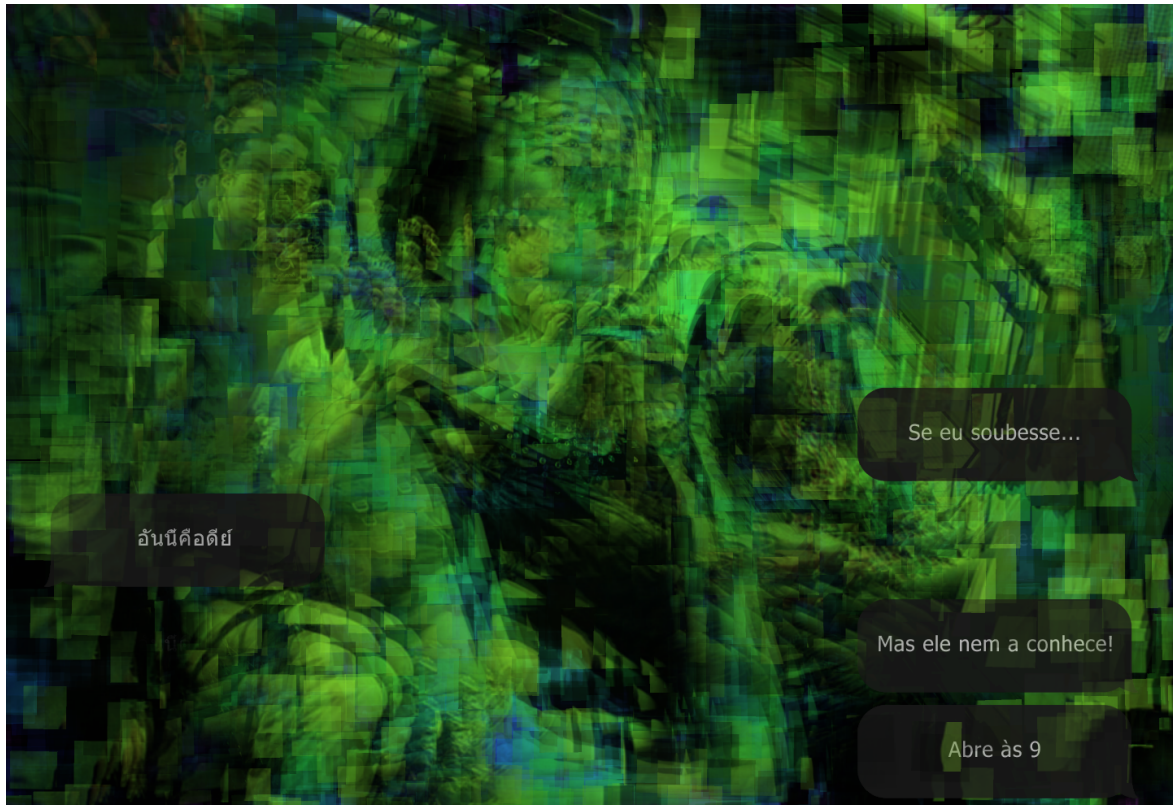


Fig. 10 A frame of *Hello*, 2020, a cinematic generative art piece, illustrative of the poetics of the mosaic and vortex (author)

The coherency and the arrangement of all elements on the screen produce a continuum that alternates between rhythmic, visual structures and descriptive symbols. Narrative elements appear and disappear again, or make room for other elements that are in competition with them. At times, the impartiality and non-interpreted quality of the database entries give rise to aesthetic and meaningful structures that repeatedly fall apart and are transformed into other constellations.

The Cultural Producer who samples from the raging flows of media detritus – endless satellite feeds, cable and broadcast transmissions, and the sedimentary layers of these through the past 25-50 years – becomes the heroic Luther, wresting deconstructive (re)form(at)ions out of the desultory, formless industrial wasteland. Deconstructive film- and video-making demonstrate the inherent formlessness of mass media by making it into the “New Nature”. (Lattanzi 2003:84)

Figure 10 shows a frame of *Hello*, a generative video art piece where images of Thai trains and suburban landscapes are combined with occasional real-time stills of the audience, and displayed as a backdrop of a text-based conversation being held in Portuguese and Thai. There is also a real-time generated soundtrack mixing sound samples captured in Portuguese trains and suburban public transports. These deconstructive (re)form(at)ions – images, the sounds, and text fragments – all stimulate the audience’s senses, allowing for a passive sensorial enjoyment, or an active deciphering of the concept and content (Veiga 2020).

These traits also determine that generative video art should be included in McLuhan’s *cool media* category, as it requires audience completion through active viewing and interpretation, with potentially different outcomes for different audience members. A

generative video artwork thus becomes a vortex of vortices, a mosaic of mosaics, a theoretical universe of all its potential outcomes, where each mosaic and each vortex are only instanced at runtime.

One final consideration – very much in line with the aesthetics of Structuralism and Futurism – derives from the fact that in some instances the technical generative system may actually be the object of (poetic and aesthetic) interest, rather than its outcome: “In a fully realized scenario, LeWitt’s dictum is extended to the point where a machine does not only make the art, a machine is the art” (Galanter 2016:168).

7 Conclusion

Code-based artworks have reached a level of maturity, going beyond simple visual experimentation to expressing more complex visions. (...) While generative art is inextricably linked to the computer as a means of production, the work is not about the computer itself. While screen-based work and the investigation of realtime self-contained systems remain an important aspect of generative art, it would be a mistake to think generative work is primarily expressed in pixels. I for one look forward to an extended rethinking of computational aesthetics that encompasses a much wider range of possible outputs. (Watz 2010:3)

Generative video art inherits a rich tradition of several art currents and movements, fostered by the current phenomenon of media convergence. We saw at the beginning of this article how the Futurist Cinema manifesto (Marinetti et al 1916) still holds its relevance, by advocating the use of analogies, cinematic poems, simultaneity, interpenetration, musical experimentalism, dramatized feelings, and sensations, using objects as metaphors, windows, unreal reconstructions of the human body, among many other traits.

It was also significant to point out how much of the current work falling within the scope of generative video art also embodies Friedman’s Twelve Fluxus Ideas (2007). However, the nature of generative video art suggests that the idea of *simplicity* ought to be replaced by *complexity*, as the art of combining order and chaos, symmetry and asymmetry.

(...) the human mind is itself constrained to find appealing those visual and auditory event combinations that share properties of both symmetry and asymmetry, hierarchical complexity and subtle disorder, and that combinations of these loosely-defined properties tend to place interesting pieces in the centre of this spectrum (Davis 1997:1).

The use of controlled randomness can be achieved through computational means during runtime (most programming languages provide functions for pseudo-random numbers generation), but also through direct human interaction or other indirect or external sources, such as data from sensors that may read audience behaviours (movement, sound, temperature, among other factors), information feeds (tweets or Instagram posts with specific hashtags, for example) or other provenances, whose control resides outside the system. And this unpredictability will not only be found in the artwork’s conceptualization, but also in its production, operation, and presentation (Grba 2017:8). Generative video art can thus cover the whole spectrum of audience participation and interaction.

As a conclusion to this article, the author now posits the following definition, inspired by Galanter's (2016:155) own definition of generative art:

Generative video art is an art form in which the artist cedes control to a system with functional autonomy. This system is designed with an initial vocabulary containing still and moving images, whose provenance is mostly external (to the system). Using a structuring device and a set of recomposition and amplification rules, the system runs within selected aesthetic boundaries, producing events that contribute to or result in a completed video stream.

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