Live visuals have become a pervasive component of our contemporary lives; either as visible interfaces that re-connect citizens and buildings overlaying new contextual meaning or as invisible ubiquitous narratives that are discovered through interactive actions and mediating screens. The contemporary re-design of the environment we live in is in terms of visuals and visualizations, software interfaces and new modes of engagement and consumption. This LEA volume presents a series of seminal papers in the field, offering the reader a new perspective on the future role of Live Visuals.
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When Moving Images Become Alive!

"Look! It’s moving. It’s alive. It’s alive... It's alive, it’s alive, IT'S ALIVE!" 
Frankenstein (1931)

Those who still see – and there are many in this camp – visuals as simple 'decorations' are living in a late 19th century understanding of media, with no realization that an immense cultural shift has happened in the late 20th century when big data, sensors, algorithms and visuals merged in order to create 21st century constantly mediated social-visual culture.

Although the visuals are not actually alive, one cannot fail to grasp the fascination or evolution that visuals and visual data have embarked upon. It is no longer possible to see the relationship of the visual as limited to the space of the traditional screens in the film theater or at home in the living room with the TV. The mobility of contemporary visuals and contemporary screens has pushed boundaries – so much so that ‘embeddedness’ of visuals onto and into things is a daily practice. The viewers have acquired expectations that it is possible, or that it should be possible, to recall the image of an object and to be able to have that same object appear at home at will. The process of downloading should not be limited to ‘immaterial’ digital data, but should be transferred to 3D physical objects.

Images are projected onto buildings – not as the traditional trompe l’oeil placed to disguise and trick the eye – but as an architectural element of the building itself; so much so that there are arguments, including mine, that we should substitute walls with projected information data, which should also have and be perceived as having material properties (see in this volume “Architectural Projections” by Lukas Treyer, Stefan Müller Arisona & Gerhard Schmitt).

Images appear over the architecture of the buildings as another structural layer, one made of information data that relays more to the viewer either directly or through screens able to read augmented reality information. But live visuals relay more than images, they are also linked to sound and the analysis of this linkage provides us with the opportunity “to think about the different ways in which linkages between vision and audition can be established, and how audio-visual objects can be composed from the specific attributes of auditory and visual perception” (see “Back to the Cross-modal Object” by Atau Tanaka).

iPads and iPhones – followed by a generation of smarter and smarter devices – have brought a radical change in the way reality is experienced, captured, uploaded and shared. These processes allow reality to be experienced with multiple added layers, allowing viewers to re-capture, re-upload and re-share, creating yet further layers over the previous layers that were already placed upon the ‘original.’ This layering process, this thickening of meanings, adding of interpretations, references and even errors, may be considered as the physical process that leads to the manifestation of the ‘aura’ as a metaphysical concept. The materiality of the virtual, layered upon the ‘real,’ becomes an indication of the composing of the aura, in Walter Benjamin’s terms, as a metaphysical experience of the object/imaginative but nevertheless an experience that digital and live visuals are rendering increasingly visible.

“Everything I said on the subject [the nature of aura] was directed polemically against the theosophists, whose inexperience and ignorance I find highly repugnant. … First, genuine aura appears in all things, not just in certain kinds of things, as people imagine.”

The importance of digital media is undeniably evident. Within this media context of multiple screens and surfaces the digitized image, in a culture profoundly visual, has extended its dominance through ‘disruptive forms’ of sharing and ‘illegal’ consumption. The reproducibility of the image (or the live visuals) – pushed to its very limit – has an anarchistic and revolutionary element when considered from the neocapitalistic perspective imbued in corporate and hierarchical forms of the construction of values. On the contrary, the reproducibility of the image when analyzed from a Marxist point of view possesses a community and social component for egalitarian participation within the richness of contemporary and historical cultural forms.

The digital live visuals – with their continuous potential of integration within the blurring boundaries of public and private environments – will continue to be the territory of divergent interests and cultural engagements. Reproducibility will increasingly become the territory of control generating conflicts between original and copy, and between the layering of copy and copies, in the attempt to contain ideal participatory models of democracy. The elitist interpretation of the aura will continue to be juxtaposed with models of Marxist participation and appropriation.

Live visuals projected on public buildings and private areas do not escape this conflict, but present interpretations and forms of engagements that are reflections of social ideals. The conflict is, therefore, not solely in the elitist or participatory forms of consumption but also in the ideologies that surround the cultural behaviors of visual consumption.

Object in themselves, not just buildings, can and may soon carry live visuals. There is the expectation that one no longer has to read a label – but the object can and should project the label and its textured images to the viewer. People increasingly expect the object to engage with their needs by providing the necessary information that would convince them to look into it, play with it, engage with it, talk to it, like it and ultimately buy it.

Ultimately there will be no need to engage in this process but the environment will have objects that, by reading previous experiences of likes and dislikes, present a personalized visual texture of reality.

Live visuals will provide an environment within which purchasing does not mean to solely acquire an object but rather to ‘buy’ into an idea, a history, an ideology or a socio-political lifestyle. It is a process of increased visualization of large data (Big Data) that defines and re-defines one’s experience of the real based on previously expressed likes and dislikes.

In this context of multiple object and environmental experiences it is also possible to forge multiple individualized experiences of the real; as much as there are multiple personalized experiences of the internet and social media through multiple avatar identities (see “Avatar Actors” by Elif Ayter). The ‘real’ will become a visual timeline of what the algorithm has decided should be offered based on individualized settings of likes and dislikes. This approach raises an infinite set of possibilities but of problems as well.
The life of our representation and of our visuals is our ‘real’ life – disjointed and increasingly distant from what we continue to perceive as the ‘real real’, delu-
sively hanging on to outdated but comfortable modes of perception.

The cinematic visions of live visuals from the 19th century have become true and have re-designed society unexpectedly, altering dramatically the social structures and speeding up the pace of our physical existence that constantly tries to catch up and play up to the visual virtual realities that we spend time constructing.

If we still hold to this dualistic and dichotomist ap-
proach of real versus virtual (although the virtual has been real for some time and has become one of the multiple facets of the ‘real’ experience), then the real is increasingly slowing down while the virtual repre-
sentation of visuals is accelerating the creation of a world of instantaneous connectivity, desires and aspira-
tions. A visuality of hyper-mediated images that, as pollution, pervades and conditions our vision without giving the option of switching off increasingly ‘alive’ live visuals.

The lack of ‘real’ in Jean Baudrillard’s understanding is speeding up the disappearance of the ‘real’ self in favor of multiple personal existential narratives that are embedded in a series of multiple possible worlds. It is not just the map that is disappearing in the pre-
cession of simulacra – but the body as well – as the body is conceived in terms of visual representation: as a map. These multiple worlds of representations contribute to create reality as the ‘fantasy’ we really wish to experience, reshaping in turn the ‘real’ identity that continuously attempts to live up to its ‘virtual and fantastic’ expectations. Stephen Gibson presents the reader with a description of one of these worlds with live audio-visual simulations that create a synesthetic experience (see “Simulating Synesthesia in Spatially-
Based Real-time Audio-Visual Performance” by Ste-
phen Gibson).

If this fantasy of the images of society is considered an illusion – or the reality of the simulacrum, which is a textual oxymoron at prima facie – it will be de-
termined through the experience of the live visuals becoming alive.

Nevertheless, stating that people have illusory per-
cussions of themselves in relation to a ‘real’ self and to the ‘real’ perception of them that others have only reinforces the idea that Live Visuals will allow people to manifest their multiple perceptions, as simulated and/or real will no long matter. These multiple percep-
tions will create multiple ever-changing personas that will be further layered through the engagements with the multiple visual environments and the people/ avatars that populate those environments, both real and virtual.

In the end, these fantasies of identities and of worlds, manifest through illusory identities and worlds within virtual contexts, are part of the reality with which people engage. Although fantastic and illusory, these worlds are a reflection of a partial reality of the identity of the creators and users. It is impossible for these worlds and identities to exist outside of the ‘real’. This concept of real is made of negotiated and negotiable frameworks of engagement that are in a constant process of evolution and change.

The end of post-modernity and relativism may lead to the virtuality of truism: the representation of ourselves in as many multiple versions – already we have multiple and concurrent digital lives – within the world’s – ideological or corporate – that we will de-

It is this control of the environment around us and us within that environment that will increasingly define the role that live visuals will play in negotiating real and virtual experiences. The conflict will arise from the blurred lines of the definition of self and other; whether the ‘other’ will be another individual or a cor-

The potential problems of this state of the live visuals within a real/virtual conflict will be discovered as time moves on. In the end this is a giant behavioral experiment, where media and their influences are not analyzed for their social impact ex ante facto; this is something that happens ex post facto.

Nevertheless, in this ex post facto society there are some scholars that try to understand and eviscerate the problems related to the process of visuals becom-
ing alive. This issue collects the analyses of some of these scholars and embeds them in a larger societal debate, hinting at future developments and problems that society and images will have to face as the live visuals become more and more alive.

The contemporary concerns and practices of live visu-
als are crystalized in this volume, providing an insight into current developments and practices in the field of live visuals.

This issue features a new logo on its cover, that of New York University, Steinhardt School of Culture, Education, and Human Development.

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1. 3D printing the new phenomenon will soon collide with a new extreme perception of consumer culture where the object seen can be bought and automatically printed at home or in the office. Matt Ratto and Robert Ree, “Mate-


My special thanks go to Deniz Cem Öndügyu who has shown commitment to the LEA project beyond what could be expected.

Özden Şahin has, as always, continued to provide valuable editorial support to ensure that LEA could achieve another landmark.

Lanfranco Aceti
Editor in Chief, Leonardo Electronic Almanac
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IMPROVISING SYNESTHESIA

Comprovisation of Generative Graphics and Music

by

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INTRODUCTION

Recent artistic practices and technologies are reshaping the definitions and categories of musical and visual artistic creativity. New categories arise, such as comprovisation. In my own creative practice, I pursue new connections between embodiment, spontaneity, and technology. Recent technologies provide opportunities to combine hierarchical process aspects of composition with the embodied spontaneity that characterizes improvisation.

For me this has led to the development of the Fluxations and FluxNoisations interactive systems, each of which enables the performer to spontaneously create – through a fully embodied immersive process – audiovisual trajectories that are expressive. Such trajectories are intended to have aesthetic value emanating from prior aesthetic experience of musical and visual art works. In this case the development of such systems has arisen through careful and systematic analysis of prior works, analysis that is computational but inspired by phenomenology of listening. For instance, new ways of systematically analyzing the flux of texture in music have inspired generative technologies; new ways to synthesize texture as controlled through bodily dance movement. The analytical and creative processes constitute a cybernetic technē, which similarly fuels the computer graphics that are generated spontaneously through these systems.

ABSTRACT

Through recent artistic practices and technology of interactive systems for music, composition and improvisation have more and more blended and interconnected with each other – a sui generis situation now called comprovisation. The concept of comprovisation applies equally well to the spontaneous generation and manipulation of computer graphics, especially as such graphics are systematically coordinated audio-visually, while being subject to spontaneous manipulation by a performer.

This is explained in terms of the Fluxations and FluxNoisations Human Body Interfaces, interactive dance systems that generate music and graphics spontaneously in response to hand and body movement. They enable spontaneous expressive shaping of coherent complexity and variety. Thus a multi-layered multimodal experience arises. The aesthetic experience of this multimedia spectacle relates to experiences of various prior music and visual art of the 19th, 20th, and 21st centuries, as well as to hypothetical physical realities. Thus a kind of cybernetic phenomenology of art is pursued and enacted through an embodied cybersynthesis of art with simulated alternate reality. Call it a pragmatic speculative realism, an adventurous technoetico ‘what if.’ As compared to more traditional forms of improvisation, the opportunities for risk-taking and aesthetic exploration rise to a new level of uncertainty, as the reactions of the improviser simultaneously draw from and target both visual and aural modalities, such that the intentions toward each fuse together.

CORPOREAL BEYOND CATEGORIES

Consider how the distinction between music composition and improvisation is blurred by the artistic practices and technology of interactive systems. In music this phenomenon has been discussed since the 1980s (by Joel Chadabe, David Rokeby, and George Lewis). Recently the term comprovisation has been coined to denote this sui generis situation, as discussed by Richard Dudas, Sandeep Bhagwati, and myself. The concept of comprovisation applies equally well to the spontaneous generation and manipulation of computer graphics, especially as such graphics are systematically coordinated across audio-visual domains while being subject to spontaneous manipulation by a performer. This paper explains comprovisation (especially
as it relates to my own artistic and technological practices) and details how comprovisation is manifested through the live computer graphics component of the Fluxations and FluxNoisations: Human Body Interfaces (interactive dance-music-graphics systems) developed by myself and Sofia Paraskeva. Figures 1 and 2 show photos from Fluxations performances in Montreal and New York. Montreal Comprovisation No.1 is shown at http://vimeo.com/fluxations/mc1.

Figure 3 shows the hardware-software setup employed in Fluxations. Several aspects of this setup were developed and employed by Paraskeva prior to the collaboration, in her multimedia installation Rainbow Resonance.


SPONTANEUS VISUAL ART PERFORMANCE?
ADDRESSING THE CHALLENGES

As Hazel Smith and Roger T. Dean argue, many kinds of graphic art are improvisatory in their creative process, which is not necessarily and not even usually observed by the art viewer. Unlike the case with music, there has not really been a tradition of live-performed improvised graphic art, mostly because of the nature of the medium, which is in many ways inherently different from music. Both music and graphic art can be experienced sequentially in a narrative way on the one hand; and can both be experienced paratactically in a synoptic way on the other. Nevertheless each has its own preferred default mode from which one gains the other kind of experience. The default mode of music experience tends to be sequential whereas the default mode of visual art experience tends to be synoptic. Though much is gained by striving against the grain, music by default is more sequential and visual art more synoptic in the way they are most immediately experienced. The prospect of live-computer graphics potentially disrupts this.
The synoptic immediacy of visual art demands that sufficient content be presented to the viewer at any moment in time; this sets up a huge obstacle thwarting the live-improvisation of visual art. How can sufficient visual complexity be generated spontaneously? How can it be improvised?

This depends partly on how improvisation is defined. Though improvisation can be defined simply as “the simultaneous conception and performance of a work,” its relevance can also “extend beyond the performing arts, in which the whole work unfolds in the presence of an audience,” as remarked by Dean and Smith. Visual art has mostly been non-performing art; yet even in this realm we can see how widespread and diverse is the inclination to improvise visual art or conceptualize visual art as improvisatory. Kandinsky’s paintings called Improvisations are obvious examples, though perhaps Andy Goldsworthy’s environmental art works are more apropos in this case, as they exploit and steer the complexity found in nature, and also respond to the “state of changes” in natural environments. Michael Snow’s chemical-heat improvisations on film stock are another example. Such examples of the improvisatory inclination in non-performing visual arts (painting, sculpture, and film), considered together with the well-known fascination with improvised live music performance, suggests that the fusion of these is even more tantalizing, if only it were possible to achieve sufficiently complex results in such a fusion. In this way Kandinsky’s, Goldsworthy’s, and Snow’s non-performing visual art improvisations underscore the urgency of this essay’s topic, which is the spontaneous creation or completion of visual art in the presence of spectators: improvisation of visual art as an observed performance. How is sufficient visual complexity to be generated in this case? How can a visual improviser break through the barrier to sufficient visual complexity?

There are certainly various kinds of visual performance art, though they are not necessarily always improvised, and usually more performative in emphasis than they are visual. That is, the interest lies in attending to the performance itself as much as to the visual art created in or through that performance. We attend more to the performing than to the performed. In the case of performance drawing, complexity arises somewhat predictably from the gradual accumulation of visual imagery.

Visual improvisation is still nowhere near as prevalent or established as musical improvisation is; nevertheless the relatively recently surging art of computer graphics animation has started to break down the complexity barrier, making it easier to generate sufficient visual complexity spontaneously in the moment of performance. Thus visual art improvisation is more viable, promising, and compelling, than it was in the past.

For example an exception that has been breaking down the complexity barrier is the practice of VJ-ing, the quasi-improvised computer graphics made with video crossfading mixing software as visual accompaniment to live computer dance music in clubs, enabled by such software as Ableton Live and Grand VJ. Usually such practices employ canned images and patterns that are combined, recombined, and filtered on the fly – this is more akin to the way a DJ mixes and filters audio clips than to the way a musician improvises. It is macro-improvising with pre-made materials.

One approach is to spontaneously manipulate complexity already in the environment for instance through live filtering, scrubbing, and processing of recorded audio or video. If done with pre-synthesized or pre-recorded sounds, this usually produces a degree of chaos that thwarts expressivity in the moment of performance. The performer can compensate for this limitation by physically making and recording in real-time the sounds to manipulate, a kind of live-musique concrète, as Michel Waisvisz famously achieved with his hands interactive system. The use of Jitter to process pre-recorded video or a live video feed is analogous to such practices. Thus such digital manipulative practices are an obvious analogical link between improvised (spontaneously created and performed) technological sonic and visual art. (Ardien Tomayko-Peters and Steve Schwartz’s Oleophobic (2010) is a recent example that employs pre-collected physical materials (colored oil and water and audio samples) to improvise a colorful audio-visual spectacle with complexity in both the audio and visual domains, though these complexities only weakly correlate with each other across the audio and visual modalities. On a more ongoing basis, in the 2000s, the audio-visual interactive performance trio Cécile Bäbirole, Laurent Dalleau, and Atau Tanaka (called Sensors_Sonics_Sights stands as one of the highpoints of the genre).

The conceptual influence of visual art on musicians and sonic artists is well recognized. Yet even tighter links are possible, through the coordination of pre-composed generative algorithms whose control input is manipulated improvisationally. In this case computer graphic art can take a lesson from music, applying this to specifically visual phenomena that are much less immediate in the sonic realm: geometry, texture, and color. Quantitative music comprovisational processes can be applied directly to these aspects of visual perception in order to manipulate complexity in live performance. Specifically, since the 1980s, but even more so recently, some technologically inclined musicians have been developing ways to “improvise” complexity, by exploiting stochastic compositional methods pioneered originally by Iannis Xenakis in the 1950s, but now expanded and implemented with live interactive generative hardware-software technology. This has been called interactive comprovisation or, since 2010, comprovisation, which is the use of technology to generate complexity that is spontaneously controllable. This is to use controlled chance procedures, stochastic methods, to produce complexity that is sufficiently and appropriately regular. Such regulated complexity cancels out, and thereby neutralizes, the features that are not being manipulated expressively in the moment of performance. This practice has interesting side effects that relate back to improvisation in a different way, as discussed in a later section of this essay.

COMPROVISATION

The philosopher Bruce Benson describes improvisation as activity between composition and performance. Though performative in its way, comprovisation – as the word suggests – straddles whatever divide persists between composition and improvisation, and does this through the use of interactive technology. Consider Comprovisation. It is a kind of musical creativity that relates composition and improvisation in an unprecedented fashion, one which was impossible to achieve with older technologies. Comprovisation is compositional in two respects: (1) it involves composing music-generating algorithms as guided by aesthetic concerns, and (2) it may involve the planned choreography of physical movements. Comprovisation is improvisational in three ways: (1) it may involve spontaneously decided physical movements; (2) planned (choreographed) movements may be spontaneously ornamented with expressive nuanced deviations; (3) the quasi-stochastic algorithm may be regarded as ‘improvising’ since its determining of certain details cannot be predicted.
As Chadabe explains it interactive composing “rede\n\nfinishes composing and performing.” He outlines a practice in which the composer creates a particular compositional process or interface and algorithmic technology with which a performer interacts to make music in a semi-spontaneous way. For example “the computer’s function in [Chadabe’s] Solo is to compose automatically the notes of a melody, its accompani\n\nment chords, and other aspects of the music, and to interpret the positions of a performer’s hands in relation to two proximity-sensitive antennas [sensors].” The player triggers changes through his movement, but cannot foresee exactly what chord will be played next. He moves in response to what he hears. The music making algorithm “responds to a performer in a complex, not entirely predictable way, adding information to what a performer specifies and providing cues to the performer for further actions.”

The situation for expressive generative graphics is analogous. Comprehension of trajectories within a flux of complexity arises not from individualistic features but rather from intensities of emergent, holistic, macro-features, which are computed as statistical tendencies. By being conceptualized and quantified as intensities, these simultaneously can serve as vessels of expression – or “vectors of transmission” for feeling as Alfred North Whitehead says – and with sufficient care and technology can be mapped from physical motions of a dancer-performer. The number of such qualities is theoretically infinite – I have researched and written on many of these in regard to music and its expressive or narrative potential. As examples consider: an intensive continuum from steady smooth rhythm to syncopated irregular rhythm, an intensive continuum from thin transparencies of consonant harmony to muddier densities of dissonance, an intensive continuum from soft blended textures to highly differentiated staccato texture.

The expressive trajectories themselves – in order to be expressive – must occur along conceptual dimensions the performer can comprehend and perceive, and which the audience might subconsciously sense or perhaps even consciously comprehend if properly instructed. Yet they need not correspond to natural sights and sounds that would be caused by the performer’s actions in the actual physical world. Neither must they exclude all connection to the dynamics of the real physical world. There is room for both. The created audio-visual world can combine realistic physics with synthetic fantasy and remain expressive as long as the continuums of its dynamism are comprehensible.

The most recent version of Fluxations has up to 15 parameters feeding into the music generating algorithm. Figure 4b diagrams the interactivity for the graphics engine. Again, continuous digital and analog input from sensors (camera and gloves) steers various aspects of the generated visual imagery: color of objects, size of objects, position of objects, movement of objects, and the backdrop color. To maintain sufficient complexity, the steering is indirect. Like the music engine, the graphics engine employs stochastic methods (random number generators and Perlin noise). Additionally, it also employs real-world physical modeling (gravity and inertia). Together, these create complexity that can be maneuvered expressively and perceived as being coherent.

MULTIMODAL IMMERSION, EXPRESSION, COMPLEXITY, AND CONTINUITY

Fluxations and FluxNoisations are operated by a musician-dancer moving around a room in front of a kinect infrared camera while wearing wireless sensor gloves,
as shown above. This movement steers algorithmically generated music and graphics. As the musician-dancer moves, the audible and visible qualities of the music and graphics are linked systematically to the performer’s motion, to enable expressivity.

Comprovisation technologies, such as these, are not just interactive but more specifically are expressive and often fluid as well: they enable a wide spectrum of smooth and abrupt changes which the performer can exert according to plan or impulse. This spectrum of kinds of changes (smooth vs. abrupt) occurs in coordination in the music and the graphics generated in Fluxations. Abrupt and smooth changes are enabled by linking intensities of macro-qualities directly to absolute and relative spatial location (position of the torso or angle of the wrist for instance). Since the physical space we move in is continuous, smooth qualitative change is effected by slow motion of the performer; abrupt qualitative change is effected by sudden motion. Since the qualities of both the music and graphics are sculpted in this way by the performer’s motion, a sudden qualitative change in the music is accompanied by a sudden qualitative change in the graphics, and vice versa; a smooth trajectory of qualitative change in the music is accompanied by a smooth trajectory of qualitative change in the visuals, and vice versa.

In this way, the graphics coordinate noticeably with the music, creating an immersive world, whose correlated audio-visual trajectories are expressively steered and sculpted like fluid by the motions of the human body moving through continuous space. Aural and visual interconnect in Fluxations. Its prismatic particle systems and fluctuating continuities of color, texture, harmony are maneuvered by the planned or spontaneous actions of the performer. The generative algorithms are designed to maximize both variety and coherence of the musical and visual experience, including cross-modal relations between them and evolving emergent patterns of particles and bubbly explosions. For instance, Montreal Comprovisation No.2 differs from Montreal Comprovisation No.1 in that, in it, my improvising emphasizes a rhythmic pulse and various degrees of syncopation; the difference in style is not achieved through any change to the system but rather through spontaneous body and glove maneuvers. (Montreal Comprovisation No.2 appears at http://vimeo.com/fluxations/mc2.)

INTERACTIVE SYSTEM DESIGN FOR MULTI-LAYERED MULTIMODAL EXPERIENCE

To maximize the variety of expression, I took a multi-layered approach to both the music generation and the graphics generation. The music and graphics each have three layers: (1) background, (2) foreground, and (3) direct interaction. There are no additional layers, beyond these six; for instance there are no pre-composed layers; all layers are algorithmically generated and interactive. The background layers continue their activity always; their qualities (colors, shapes, locations, distributions, rhythms, harmonies) affected by the performer’s movement. The foreground layers activate to varying degrees in response to right-hand wrist flexing of the performer. Their qualities are also affected by the full body motion of the performer. The direct layer is the only one that allows the performer to initiate an event directly, by pressing a button on the left-hand glove, which triggers a percussive attack synchronized with a bubbly explosion of colors, whose qualities are systematically coordinated with the four other visual and audio layers. The wireless sensor gloves – which also affect several qualities of the other visual and audio layers – were designed, built, and programmed by my collaborator Sofia Paraskeva in consultation with me, expanding on an earlier version of her gloves which predated our collaboration. Figure 5 shows the progress of two successive bubble explosions each directly initiated from the glove during Montreal Comprovisation No.1.

The three visual layers link to each other through their emphasis on ellipses. The size, shape, position, movement, and color of these ellipses vary in all three layers according to the position and movement of the performer, but the way these vary in each layer is different. That is, the systematic dependency of ellipse size, shape, position, movement, and color is different in the background layer as compared to the foreground layer, and is different again in the direct layer.

Though not identical, neither are the layers independent of each other. Their activities mutually interact. For instance the music engine’s pool of pitches systematically expands, contracts, and shifts, according to the performer’s position, but at all times this dynamic pool is shared by all three music layers. Thus the harmonic coherence of the entire complex surface of the music is orchestrated under all conditions of simplicity and complexity, of consonance and dissonance, as well as sudden vs. gradual change.

Though no one aspect binds them all together, the three visual layers also intersect in various ways. For instance the direct layer and the foreground layer share a pool of colors which shifts dynamically according to the position of the performer. The background layer itself consists of a solid backdrop and a particle system, the colors of each of which fluctuate differently. Both, however, present activity whose vertical and horizontal position on the screen correlates to the vertical and horizontal position of the performer’s left hand. (The left hand movement perturbs the miniature bubbles which comprise the background layer’s particle system; the left hand movement also determines the source location of the direct layer’s bubble explosions.) The foreground layer determines position by a different strategy. It uses the Perlin noise function to determine the location of its objects. I used Perlin noise (smooth randomness) to determine the coordinates of the ellipses because I want the eye to follow each new ellipse when they occur in quick succession as happens at fast tempos. To be noticed, a newly appearing ellipse should appear nearby the previous one, which increases the likelihood it will catch the attention of the observer’s darting eyes. The random but smooth nature of Perlin noise tends to ensure this

THE POETICS, TECHNÉ, TECHNOTICS, OF
FLUXATIONS: PRAGMATIC SPECULATIVE
REALISM

As in the everyday world we experience, countless nuances of movement produce some or other result through elaborate semi-predictable systems of cause and effect in Fluxations. Yet its cause-and-effect dynamics are deliberately unconventional. In programming interaction responsive music- and graphics-generative software, one could demonstrate such cause-and-effect responsiveness in a conventional way by reproducing, amplifying, or emulating the sights and sounds actually physically produced directly by the user: the sound of a foot hitting the floor, the image of a body moving across the room.

Yet this seems hardly the point in the artistic realm, including improvisation. To reproduce exactly and only the same cause-and-effect dynamics the everyday world has might be science, engineering, or entertainment, but not art, which is both less and more than reality. Indeed, Roy Ascott’s concept of “technotics” promotes the role of technologically mediated art practices for expanding consciousness and creating meaning, as opposed to profit-motivated use of technology. 60

Whether subscribing specifically to Harold Bloom’s “anxiety of influence” theory or not, it is hardly controversial to acknowledge that artists learn from appreciative-critical reception, interpretation, and analysis of previous art, even if technology is employed in their subsequent creative responses. 59 Every aspect of artistic craft – whether inherited, refined, or invented anew – is itself a kind of technology, falling under Aristotle’s category techné, which was in 2011 the basis for an ISEA panel discussion, and now a forthcoming book exploring the thesis that “the creation of work is the creation of concepts, joining the efforts of theory and praxis in one process (techné), and that the results of our works are the expression of an ontological proposition (worldmaking).” 62

Through an intricate techné of interactivity-to-algorithm parameter mapping, Fluxations provides its own musical and visual living environment: not one that mimics the everyday world exactly, but rather one that presents a flux of coherent complexity, and, in so doing, maximizes one’s ability to explore and experience a coherent interweaving of sights and sounds I have found aesthetically appealing in works by great composers, painters, and visual artists. These include composers such as Wagner, Liszt, Schoenberg, Varese, Stravinsky, Crawford Seeger, Wolpe, Carter, Babbitt, Ligeti, Reich, Riley, and Parich, improvisers such as Charlie Parker, and visual artists such as Kandinsky, Moholy-Nagy, Clyfford Still, Jackson Pollock, Helen

while providing lively motion, so the ellipses seem to dance around the center of the screen, as shown in Figure 6.

The size of the foreground layer ellipses maps directly to the tempo (temporal density) of the music, which is controlled by flexing the left wrist and by tempo multiplier buttons on the left hand. Larger ellipses correlate to slower tempos, their size and rate of appearance are thus made inversely related. It adjusts to all the gradations in the aural and visual field of perception: from perceiving events individually, on the one hand, to perceiving an emergent texture of event multitudes, on the other.

The video Full Body Comprovisation No.1 illustrates some of these interactions in three overlapping expressive trajectories. It shows increasing tempo with decreasing ellipse size, then increasing color hue variety, with increasing color hue variety, then gradually closing the lowpass frequency filter (muffling the sound) with darkening the background (gradually to black); three trajectories in succession created by flexing the left wrist, moving forward toward the camera, and then moving the hands closer together (shown in the video clip at http://vimeo.com/fluxations/vid3).

Of course the most obvious cross-modal link in Fluxations is rhythm. Both the visual and the aural streams share precisely the same foreground rhythm. This is most obvious when the foreground rhythm is synchronized, an effect controlled by degree according to the bending of the left wrist. The videos: Firefly Fury and Full Body Comprovisation No.2 illustrate such flux of syncopation, along with other trajectories of flux. (This is shown in three clips: http://vimeo.com/fluxations/vid4, http://vimeo.com/fluxations/vid5, and http://vimeo.com/fluxations/vid6.)

Besides rhythm, Fluxations embeds numerous other subtle cross-modal links, which can serve as vessels of bodily expression. One example is that the hue of the solid backdrop in the background layer smoothly shifts according to the lateral movement of the performer; simultaneously the pitch pool of the music engine smoothly shifts (transposes) around the circle of 5ths according to that same movement. Proximity between the performer’s hands smoothly affects the darkness vs. brightness of the backdrop as well as the closing and opening of a low-pass frequency filter (timbral darkness vs. brightness) in the music engine.

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Figure 6. Dance of the ellipses (Perlin noise dance): The proximity and ordering in which foreground layer ellipses appear at their locations are determined by the smooth randomness of the Perlin noise function. Fast tempo excerpt from Full Body Comprovisation No.1 at 4:22 (direct screen capture), Joshua B. Mailman, 2012. © Joshua B. Mailman, 2012. Used with permission.

Figure 7. Stills from “Firefly Fury” (Marathon Demonstration), Joshua B. Mailman, 2012. In a bubble explosion, the translucent colors of the large bubbles (oriented to a blue hue) interact as they overlap, reminiscent of the early 20th century artworks of Kandinsky and Moholy-Nagy. Because of motions of the hands and body, in the last two frames the background darkens and the small ellipses in the background particle system shift from green to lavender. Photos by Danielle Y. Robinson. View the video at http://vimeo.com/fluxations/ff. © Danielle Y. Robinson, 2012. Used with permission.
Frankenthaler, Stan Brakhage, Harry Smith, John Whitney – even Damien Hirst. For instance, the still frames in Figure 7, captured from “Firefly Fury,” relate to the use of superimposed translucent circles in some art works of Kandinsky and Moholy-Nagy. At the top of Figure 8, the dark images with light vertical irregular wedges through their middles, at the moment they arose during the performance, reminded me of Clyffird Still’s paintings. Those images beneath vaguely suggest some synthesis of Helen Frankenthaler, Jackson Pollock, Damien Hirst, and Monet watercolors – each image emerging from my spontaneous dancing, as interpreted by the algorithms of Fluxations. I was somewhat aware of the associations during the performance. I was also vaguely aware of their possibility when designing and adjusting the algorithms.

Some of the music analyses that inspired Fluxations, have themselves been computational, constituting a cybernetic phenomenology of music. That is, some of what I learned from all sorts of theorizing, analysis, and casual observation I have programmed into the generating algorithms of Fluxations as well as FluxNasations. The logistics of these systems are designed to maximize variety with respect to such diverse artistic styles, while also organizing such diversity into a dynamical coherence of cause-and-effect flux. This is interpretive analysis, systematic theorizing, and creative practice all in one process: techné, as a worldmaking endeavor.

The techné used to create Fluxations – its immersive world of fluid dynamism – derives partly from cybernetic phenomenology of art (music and visual art), but not exclusively. The techné for this interactive system fuses with the techné of simulating real-world physical systems, such as the velocity- and proximity-responsive motion of particles in fluid and the effects of inertia and gravity on elements emitted from an explosion. The affective results of artistic developments and real-world physics fuse together in the synthetically immersive environment of Fluxations. To do this, for instance, I programmed the elements emitted in the direct layer explosions to wobble like real bubbles moving through the air, even though real bubbles do not partake in explosions in the real world. Also I adapted Andrés Colubi’s GPU particle system algorithm which is distributed as part of his GLGraph library for Processing. Simulating physical reality, the background layer particles move in proportion to the proximity of a disturbance and the speed of that disturbance. (As mentioned above, the disturbance in this case is the detected motion of the performer’s left hand.) Yet, to this simulation of real-world physics, my adaptation contributes distinctively non-realistic (surrealistic?) behavior. I make the size and color of the particles vary according to the posture and position of the performer – a behavior that bears no obvious relation to ordinary physical reality.

Art – and specifically interactive technological art – is the opportunity for physically enacted adventures of thought. Separating out some aspects of reality and resynthesizing these with unreal behaviors creates a dynamic alternate reality to experience – a pragmatic techné fueled pursuit of speculative realism, which Ian Bogost writes about as alien phenomenology, which I write about in relation to music and media, and which was hinted at by Roy Ascott who writes:...
Art is a form of world building, of mind construction, of self-creation, whether through digital programming, genetic code, articulation of the body, imaging, simulation, of visual construction. Art is the search for new language, new metaphors, new ways of constructing reality, and for the means of redefining ourselves. It is language embodied in forms and behaviors, texts and structures. When it is embodied in moistmedia, it is language involving all the senses, going perhaps beyond the senses, calling both on our newly evolved cyberception and our rediscovered psi-perception. Mostmedia are transformative media; moist systems are the agencies of change. The moist environment, located at the convergence of the digital, biological, and spiritual, is essentially a dynamic environment, involving artificial and human intelligence in non-linear processes or emergence, construction, and transformation.

It is quite an adventure. Ascott is here inspired by the visionary pragmatism espoused by philosopher Richard Rorty, who “eschews the sanctity of philosophy in favor of the artist’s visionary impulse and search for metaphor that leads to the continual construction of reality and of the self, thereby denying the passive acceptance of any canonical description of reality.”

Where’s the pragmatism? It relates to what I said above about perceiving coherence in a flux of complexity. That is, with the live visuals of Fluxations, the pragmatic payoff comes from exploiting and repurposing our usual ability to make sense of the dynamic environment we live in. Specifically, the primary aspects of the real-world simulating particle systems enable the flux of complexity – sometimes a turbulent storm of colorful activity – to be perceived as somehow coherent, despite its departures from ordinary reality. Through so much experience, we are used to comprehending the complex motions of liquid dynamics, to such an extent that such comprehension is not foiled by systematic changes to the coloration and proportionality of the liquid components. The perception of alien but coherent complexity sails on the winds of familiar naturalistic physics.

The role of liquid dynamics and fluidity is not coincidental. It relates to Ascott’s focus on “moist” to depict a “post-biological” juncture of humans and machines (the “wet” and “wired” merged). Liquid stands iconically for the fascinating coherent complexity of life, of the dynamism of living organisms. I have previously discussed the narrative resonance of water sounds in electroacoustic music, and how this influences the conceptualization of musical form. I have also previously addressed ways in which poetic allusions to naturalistic-meteorological metaphors of flow (rivers, winds, torrents) influence the interpretation of musical form. A fluid conception of musical form, what has been called dynamic form, has been the driving force behind the design of the Fluxations’ interactive system. An example of such an influence is my own prior use of liquid metaphors to name emergent qualities of musical texture that I modeled cybernetic phenomenologically. These same textual emergent qualities ultimately inspired aspects of the music engine of Fluxations, and then its live visuals as well.

In modeling a fluid conception of musical form (dynamic form), I am drawn to the flux of polyphonic texture in Renaissance (15th century) music of Dufay and Isaac as well as in modern (20th and 21st century) music of Ruth Crawford Seeger and Robert Morris. In terms of the notes in which their compositions are written down, the liquid emergent qualities of a polyphonic texture can be defined as intensities. For instance, the viscosity of a span S of music can be defined thus:

\[ \nu \text{Viscosity}(S) = \frac{\sum (w_i)^2}{\sum w_i} \]

where \( w \) denotes the duration of an event (the duration for which a note is sustained), this is the sum of the squares of the durations divided by the sum of the durations, the reasoning for which I explain elsewhere.

Such composed textural flux inspires the improvisatory control of textural flux enabled by the music engine of Fluxations, as shown in Figure 10. Here the dancer-performer is shown increasing viscosity (decreasing fluidity) of the generated music by lowering his body toward the floor.

The same action also increases the size of the bubble particles in the background layer of the live visuals, which is accomplished with the following line of Processing code:

\[ \text{bubble} = \text{bubble} + \text{mouse} \]

Figure 9. The fluid form of the beginning and ending of Morris’s In Concert (2001), depicted in terms of the textural vessel: viscosity. This is shown computed measure-by-measure (top) and section-by-section (bottom). © Joshua B. Mailman, 2012. Used with permission.
renderPartFilter.setParameterValue("brush_size", maxHeadHandsHeight);

The color hue of the background layer’s bubble particles changes according to the direction the performer is facing, measured as the distance between left and right shoulders along the horizontal (x-axis) plane.

Colubri’s GLgraphics particle system acts as a kind of dynamic stencil whereby what appears as a backdrop is actually a curtain with moving holes that represent the particles; their color is the background color that shows through. Therefore I create the shoulder driven control of bubble particle color in the background layer with the following line of Processing code (which is in HSB):

```
background( scaleShoulderWidthTo255(abs(Lshoulderx – Rshoulderx)), 255, 255, 255);
```

The correlation between shoulder orientation and bubble particle color, and, as explained above, the correlation between vertical position of the body, the textural viscosity in the generated music, and the size of bubble particles in the background particle system are aspects of a dreamt-up system, behaviors of an invented world of coherent cause-and-effect, a physical-technologically enacted “what-if.” Three video clips...

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**Figure 10.** Vertical position of the body controlling music texture and particle system bubble size in **Fluxations**, Joshua B. Mailman, 2012. Viscosity (vs. fluidity) of the music texture and the size of the particle system’s bubbles are both controlled by crouching vs. standing upright. Each varies on a continuum. Varying degrees of viscosity in the music texture (left column): vertical positions (center column); varying size of bubbles in the particle system (right column). Photos by Sofia Paraskeva © Joshua B. Mailman and Sofia Paraskeva, 2012. Used with permission.

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**Figure 11.** Filling in (populating) blue space and the circle 5th harmonic space by moving forward. From fewer hues and more shades to more hues and fewer shades (left column); from distant to close to the camera (middle column); and hollow to full harmonic space (right column). Photos by Sofia Paraskeva. © Joshua B. Mailman and Sofia Paraskeva, 2012. Used with permission.
DESIGNING AN IMMERSIVE INTERACTIVE ENVIRONMENT FOR COMPROVISATION OF COLOR AND SHAPE TRAJECTORIES

The live visuals of *Fluxations* are designed to optimally balance some potentially competing priorities: (1) Enable both smooth and abrupt change to musical and visual qualities through corresponding smooth vs. abrupt motions of the body, such that these changes and their correspondences could be witnessed by an observer; (2) Enable maximum varieties of change: as many kinds of change as possible, having multiple aesthetic appeals, each accessible at the discretion of the performer; (3) Ensure internal coherence of the system's dynamism (avoid arbitrary unconnected transitions between states); (4) Systematically correlate visual flux with musical flux and vice versa (algorithmic synesthesia); (5) Ensure that the generated music and visuals are, as often as possible, aesthetically appealing according to my own phenomenology of prior musical and visual art works, my knowledge of musical and visual art theories, and what is known about audio and visual perception and cognition; this last consideration includes the tendency towards sufficient complexity, so the observer-listener remains captivated.

![Image](https://via.placeholder.com/150)

*Figure 12.* Stills from “Firefly Fury”: Marathon Demonstration, Joshua B. Mailman, 2012. Showing gradual increase of color hue variety in the foreground layer: it starts with just shades of blue (when in the farthest back position), then expands to include purple and green (as the dancer moves forward), and then expands further to include a yet broader range of hue: red, yellow, orange, the whole rainbow (as the dancer moves even closer toward the camera). Photos by Danielle Y. Robinson. View the video at [http://vimeo.com/fluxations/ff](http://vimeo.com/fluxations/ff). © Danielle Y. Robinson, 2012. Used with permission.

In the generated graphics, the range of color hue of the direct layer and foreground layer ellipses and the kind of pitch-class set (arpeggiated chords) chosen by the music algorithm are all controlled by the performer’s forward vs. backward location. Backward position chooses narrower ranges of hue and smaller pitch-class sets (fewer distinct pitches). For instance, in one of the color modes, when the dancer-improviser is in the back position (away from the camera), the ellipses are blue; then moving slightly forward, the hue range expands to include purple and green, and then expands further (as in Figure 12) to include a broader range of hue: red, yellow, orange, indeed the whole rainbow.

Three excerpts from *Firefly Fury* illustrate such dynamism. The first one shows increasing hue (and pitch) variety in the foreground layer; the second excerpt projects a decreasing then increasing trajectory of hue (and pitch) variety, also in the foreground layer. The third clip (which is from near the end of the 15-minute improvisation) shows increasing then decreasing hue (and pitch) variety, this time in the direct layer, that is, in the bubble explosions. The three excerpts are shown here: [http://vimeo.com/fluxations/vid9](http://vimeo.com/fluxations/vid9), [http://vimeo.com/fluxations/vid11](http://vimeo.com/fluxations/vid11), [http://vimeo.com/fluxations/vid12](http://vimeo.com/fluxations/vid12).

At the same time, however, the color field theories of Johannes Itten and Joseph Albers are implemented dynamically in the system, in this way, as Figure 13 depicts it: when increasing the range of hue by moving forward toward the camera, the range of shades (brightness levels) gradually decreases. So now compare depth positions in the performance space. At the back position, where a narrower range of hue is enacted (just blue), a wide range from dark to light shades occurs; moving forward toward the camera, the range of brightness gradually narrows, excluding darker shades more and more. (Refer to Figures 11 and 13.) This way the performer triggers a variety of colors at every position, but the kind of variety (hue vs. shade) varies according to position, and thus the flux of kind of variety also acts as a vessel of expression for the improvising performer to sculpt trajectories of intensities over time (temporal dynamic form). As with the generated music, so also the algorithmic and interactive technē of the visual imagery are designed to coordinate continuous spatial logic with visual aesthetics inspired by abstract paintings, sculptures, and film.

![Graph](https://via.placeholder.com/150)

*Figure 13.* Inverse relation between variety of hues and variety of shades, effected by varying distance from the camera. © Joshua B. Mailman, 2012. Used with permission.
It’s important to stress that comprovisational technology such as Fluxations enables a different kind of expressive control than usual musical instruments offer. For instance, enabling an improvising performer to use smooth flux of degrees of color to visually project dynamic form over time (temporal dynamic form, form from flux of intensity, narrative form, asynchronous form) is not something an ordinary musical instrument does. It’s not even analogous to an ordinary musical instrument. Fluxations also lets the performer smoothly increase and decrease the variety of ellipse height and width in the foreground layer and the variety of note durations in the musical texture, by moving his or her feet closer together or farther apart, an effect heard (and briefly seen as well) in Firefly Fury at 11:35-12:55, a passage that starts a 40 seconds into the following clip. Yet there is more. In addition to showing trajectories of temporal喇叭 variety and ellipse height and width variety, this video excerpt also has flux of syncopation (controlled by the left wrist) and flux of pitch variety and hue variety, in the direct layer and the foreground layer. (The passage is shown here: http://vimeo.com/fluxations/vd13.)

The feet don’t just dance; they also steer the music and graphics. The correlation of feet distance to duration and size variety thus enables yet another kind of expressive trajectory in improvised performance. To the viewer-listener such degrees of variety (of color, size, shape, and duration) are not features of individual events but rather emerge over some duration of time; they also relate to various aesthetic-perceptual situations that emerged in the viewer-listener’s past experience. In these respects, such qualities are emergent. Through such technology as Fluxations, for the first time a number of such emergent features of music and animated graphics are brought within the realm of spontaneous expression. These are features that previously could be manipulated only through non-real-time composition, which is where I learned them from, mostly through cybernetic phenomenological analysis of works I admire.

**DIALOGIC INTERACTION IN IMPROVISATION (INTRA-MODAL)**

As I suggested above, Fluxations is a comprovisational system because it embeds some compositional aesthetic decisions into its algorithms. Nevertheless, it being an interactive system, much of what is heard and seen through it is determined by the dancer-musician during performance and thus is not determined in advance – indeed many aspects decided by the algorithms are also not determined in advance, but rather are decided during the flow of performance. (None of the video clips presented here were pre-choreographed or otherwise predetermined.) For these reasons, it’s most pertinent to discuss Fluxations performance as improvisation, and consider how the performer’s decisions come about.

In discussing improvisation, Benson remarks that sometimes intentions evolve during the act of creation. More than anything, this characterizes the spontaneity of improvisation. An improvisation implies that the decisions about what sounds or sights are to be enacted are not all decided in advance. Thus improvisation is a recursive feedback process, in which decisions are made in response to what was seen or heard in previous moments of the improvisation. As Smith and Dean describe it, “this process involves a dialogue within the medium, so that each gesture becomes a ‘response’ to the ‘call’ of a previous one.” This includes the seeming “landing on a wrong note,” if such a thing exists, for no improviser who is truly challenging himself is fully in control of every nuance of sound; unexpected details crop up when interacting with any technology, whether it be a saxophone or a Max patch. Adventurous improvisers embrace such uncertainty. In an improvisation, each gesture can imaginably produce significant modifications in the total sound and musical development.

In group improvisation, this indeterminate action-reaction dynamic is part of the purpose of George Lewis’s interactive composition system, as is the case more generally with interactive composition and improvisation. Improvisation presents the opportunity to respond to the unforeseen particulars of a situation as they come up, and such algorithmic systems as Lewis’s Voyager and Rowe’s Cypher provide the opportunity for the technologist-programmer/musician to explore the possibilities of such dialogic interaction in ways beyond typical human-human improvisation. Pursuing dialogic interactivity in a new way is part of the purpose of George Lewis’s Voyager interactive systems.

In such systems, typically the improvising algorithm is responding to sounds or individual notes played by the human improviser, as diagrammed in Figure 14c. In an interactive composition system, by contrast, such as Chadbob’s or a comprovisational system such as

**Figure 14. Call-and-response flow diagrams depicting the dialogic intentional aspects of improvisational interaction.** Seven contexts are shown: (a) Solo improvisor; (b) improvisational music duo (human+human); (c) Cyber-improvisational duo (human+machine); (d) Solo comprovisation or interactive composing, of audio only; (e) Solo comprovisation or interactive composing, of visuals; (f) Improvisational visuals duo (human+human); (g) Solo comprovisation or interactive composing, of audio and visuals. © Joshua B. Mailman, 2012. Used with permission.
Fluxations, things works a bit differently, since the performer is not actually producing individual sounds or playing individual notes on an instrument. Instead, actions of the performer feed directly into computations which produce sound (or visuals) without passing through an intermediate stage that might be heard or seen by an observer. Figure 14d and 14e diagram this situation, the situation of interactive composing or comprovisation (of music or visuals). Indeed it is this very aspect that enables such systems to give the performer direct control of emergent flux. Since all actions are mediated by the system, none of their side effects can distract from or interfere with the performer’s expressive projection of emergent flux trajectories. Rather than using sound sources (or source images) from the performer, the system lets the performer directly steer many qualitative trajectories of the complexity it produces purely through its algorithms.

Nevertheless, although trajectories of flux are under the performer’s control, the details are not, the details that comprise the complexity are stochastically “improvised” by the algorithms as affected dynamically by the performer’s interaction. There is the adventur-ous uncertainty again – opportunities to respond to the unforeseen. Although comprovisation tends to focus on expression, its details are not fully controlled, and thus may present partly unforeseen situations, to which one responds in the moment. Thus, as with interactive systems of Lewis, Rowe, and others, Fluxations is not only interactive in the sense of enabling a dialog between human and machine, presenting cybernetically situated opportunities to react to an ongoing stream of uncertainty.

**AGENT-EFFECT COMBINATORICS OF INTENTION IN MULTI-MODAL INTERACTIVITY**

Yet the multimodal (audio-visual) aspect of Fluxations brings another twist, one that I did not anticipate until I started interacting with it. This concerns the dialogic nature of improvisation and what can be learned about it through technology-based interactivity, that is, through cybernetic embodied exploration of spontaneous expression. Consider first that the emergent features discussed above are emergent within the listening domain and within the visual domain. But their cross-modal interaction creates yet another higher level of emergence. How does this affect the intentionality of improvisation? To be more specific, I want to consider how the pursuit of new dialogic interactivities indeed advances into new territories when exploiting cross-modal comprovisational technologies such as Fluxations, and even moreso in FluxNoises.

Consider that bringing new multi-modal vectors of expression within reach of the improviser also brings new forms of spontaneous dialog into improvisation. Notice that Figures 14a-e only depict one event: the performer and the resulting sound or visuals. That is an example of cross-modal dialog, where the performer’s follow-up actions are targeted toward an event in the modality of his instrument. For instance each sound-producing action is a response to a previous sound, thus an intention to produce a result in one modality (sound) in response to an event in the same modality (sound). One can imagine another situation, such as depicted in Figure 14f, where each improviser is responding to events of another modality (for instance a musician reacting to a dancer or other visual artist, and vice versa), though it’s hard to imagine he or she isn’t also responding previous events in his or her own modality (depicted in pale grey dashed lines). Either way, each improviser’s follow-up actions are targeted toward an event in the modality of his instrument. For example the musician’s follow-up actions are each directed toward making the next sound, that is, toward some sonic result.

Figure 15 organizes the dialogic interactions of Figures 14a-f in terms of the modalities in which an initiating event occurs (listed vertically on the left) and the modalities toward which a follow-up action is directed (listed across the top). For instance the dialogic interactivities of Figures 14a-d are depicted in the upper left cell of the table; each is intra-modal: sonic-to-sonic. Figure 14e is also intra-modal: visual-to-visual (the table’s center cell). Figure 14f, by contrast, is cross-modal: sonic-to-visual and visual-to-sonic, and perhaps also convergent, since an improviser is often responding to the results of her own prior actions. When improvising with Fluxations, sometimes I seek a certain sonic result, but as I achieve it, I am seduced by the particular visual configuration that emerges, which then lures me into focusing on improvising the visuals. That is an example of cross-modal dialog.
interactivity in Fluxations. For instance in one passage in *Fully Body Comprovisation* (200–447) I went back and forth several times, first targeting a certain emergent sonic result, then a visual one, and so forth; often the side effects of one would prompt the other and vice-versa. (The passage is shown here: http://vimeo.com/fluxations/vid14.)

What hasn’t been addressed so far is how all these come together in an unprecedented way in Fluxations and FluxNoisations. Figures 14a-f fail to depict the essence of the dialogic interactivity of these systems. With these systems the performer responds to both sonic and visual events (that he and the algorithms effected previously) and responds by targeting either sonic or visual results, or both, as diagrammed in Figure 14g. In this case the situation may approach what Michel Chion calls *synchresis*: an immediate and necessary relationship arising between what one sees and what one hears. It relates closely to synesthesia. In regard to dialogic interactivity, both are denoted in the bottom right cell of Figure 15: a sonic/visual stimulus prompting a sonic/visual aimed action: dialogic interactivity that is synesthesic, or synchresic.

**SPONTANEITY, REACTIVITY, AND UNCERTAINTY**

I already discussed some uncertainties inherent to improvisation and algorithmic interactivity. An improviser truly challenging himself is uncertain even of some of the immediate outcomes of his own actions. In an ensemble setting, an improviser is uncertain what other players will do. Performing with an interactive system, the improviser is uncertain what details the algorithms will produce. What I’ve been suggesting is that yet another uncertainty arises when being able to simultaneously improvise macro-features (emergent properties) of mutually coordinated computer music and graphics through motions of the whole body cybertically entangled. This uncertainty is as much retrospective as prospective. It is an uncertainty about one’s own expressive intentions: past, present, and future. I find that the more I improvise with Fluxations, the more trouble I have disentangling when, and through which actions, I am aiming at a visual emergent effect vs. a sonic emergent effect. (Perhaps it is a little like tap dancing, which is also bodily enacted bi-modal visual and sonic presentation – except the experience I am discussing is much more peculiar, because it is so immersive, intense, and beyond routine.) I am not even sure if such intentions could be distinguished – or should be – if indeed they arise as part of a synesthesic experience. A kind of synesthesia arises from improvising with the system.

I encounter the same blend of improvisatory bodily intentions working with FluxNoisations, a new system involving percussive noise and symmetry-based generative geometries whose configurations and colorings are controlled interactively. Figures 16 and 17 show some color geometries that arose in an improvised demonstration. Demonstrating this more clearly is the 20-minute video compilation FluxNoisations Potpourri shown here: http://vimeo.com/fluxations/fnp. In this video footage I am shifting my hands, shoulders, elbows, and sometimes my whole body, striving to stabilize an interesting geometric configuration or segue between nuanced differences of geometric configurations and carefully cycle back and forth between segments of the rainbow color continuum that are circulated through these symmetries. At the same time however, I am trying to choose certain noise and percussion pulses over others, transition between them, and achieve certain sonic combinations; all these spontaneous intentions intertwine in performing in/with FluxNoisations.
We believe animated systems entailing motor-sensor apprehension of “material based imagination,” which involves “a tight connection between motor-sensor apprehension and imaginative experience.” The enigma need not necessarily be unraveled. As Benson explains “Improvisation presents us with something that onlycross-modal (sound and visual) interaction might seem to lead to an application of Gilles Faucon-...
26. For a discussion of the UJ culture as well as more painterly audio-visual interactive work such as Golan Levin’s Scribble (2000), see Chris Saltar, Entangled: Technology and the Transformation of Performance (Cambridge, MA: The MIT Press, 2010), 172-79.

27. The spontaneous manipulation pales in comparison to the idiosyncrasies of the source material being manipulated.


36. Joshua B. Mailman, “The Fluxuations Stochastic Interactive Algorithmic Music Engine (SIAME) and iPhone App.”


41. Joshua B. Mailman, “The Fluxuations Stochastic Interactive Algorithmic Music Engine (SIAME) and iPhone App.”


46. Ibid.


53. Stochastic methods for creating music were primarily the innovation of Iannis Xenakis (1971). Refer to the mention of Xenakis above in [33].

54. Nevertheless, there might be reasons to use other methods such as markov chains or L-systems.

55. For my discussion of music interactivity in regard to a related iPhone app employing an earlier version of the music generative algorithm, see Joshua B. Mailman, “The Fluxuations Stochastic Interactive Algorithmic Music Engine (SIAME) and iPhone App.”

56. Paraskeva demonstrated an earlier version of her gloves in 2010. See http://www.sofiart.com. In addition to making the gloves, Paraskeva participated in many other aspects of the system’s development, including programming, calibrating, testing, demonstrating, and proposing some of the modes of interactivity that are implemented in the system.


63. Joshua B. Mailman, “Temporal Dynamic Form in Music: Atonal, Tonal, and Other.”

64. Joshua B. Mailman, “Interactive Computer Simulation for Kinesthetic Learning to Perceive Unconventional Emergent Form-bearing Qualities in Music by Crawford Seeger, Carter, Ligeti, and Others.”
65. Joshua B. Mailman, “Seven Metaphors for (Music) Listening: DRAMATIC.”
68. Andrés Colubi, “HD (in) Processing,” ACE’08, Yokohama, Japan, 2008 http://users.design.ucla.edu/~acolubi/pro-
70. Ian Bogost, Alien Phenomenology, or What It’s Like to Be a Thing (Minneapolis, MN: University of Minnesota Press, 2012).
74. Ray Ascott, “Art @ the Edge of the Net: The Future Will be MoIST!”, 366.
83. Joshua B. Mailman, “Temporal Dynamic Form in Music: Atonal, Tonal, and Other.”
84. Joshua B. Mailman, “Emergent Flux Projecting Form in Ruth Crawford Seeger’s Quartet (1933).”
86. Joshua B. Mailman, “Seven Metaphors for (Music) Listening: DRAMATIC.”
87. Joshua B. Mailman, “Interactive Computer Simulation for Kinesthetic Learning to Perceive Unconventional Emergent Form-bearing Qualities in Music by Crawford Seeger, Carter, Ligeti, and Others.”
89. Joshua B. Mailman, “ Emergent Flux Projecting Form in Ruth Crawford Seeger’s Quartet (1933).”
90. Ibid.
92. Because CRCSeleton sets the top of the field to 0, the mazeHeadHeight actually increases as one lowers the body toward the floor.
93. Note that Processing’s “background” function does not correlate exactly to what I call the “background layer” of the Fluxations interactive system. The background layer of the interactive system also includes the backdrop behind the particle system, which is painted by a different line of Processing code.
98. Hazel Smith and Roger T. Dean, Improvisation, Hypermedia and the Arts since 1945, 105.
100. David Borgo, Sync or Swarm: Improvising Music in a Complex Age (New York: Continuum, 2007).
102. David Borgo, Sync or Swarm: Improvising Music in a Complex Age.
103. Marcel Cobussen, Henrik Frisk, and Bart Weijland, “The Field of Musical Improvisation” Konferen: Interdisciplin-
104. The reader is also referred to Figures 17 and 18 on pp.172-
3 of Smith and Dean’s Improvisation, Hypermedia and the Arts since 1945. Those diagrams explore several other aspects of solo and group improvisational interactivity.
105. There are many other responsive aspects of improv-
sational interaction besides such a series of discrete call-and-response pairs. For instance, the more ongoing feeling of groove might be created, as explained by Vincent Meebelg, “a sense of propulsive rhythmic feel,” which can induce one’s body to move (or “vibrate”). Groove is induced both through sound (physical vibration) and through visual observation — since “performing actions and observing actions activate the same brain areas.” When performing Fluxations my body often feels propelled into kinetic pulsation because of the rhythmic groove created by the algorithm, which I am also ma-
106. Hazel Smith and Roger T. Dean, Improvisation, Hyperme-
dia and the Arts since 1945, 37.
107. The reactive aspects of improvisation such as these are discussed in a number of studies including Pat G.T. Healey, Joe Leach, and Nick Bryan-Kinns, “Inter-play: Understanding Group Music Improvisation as a Form of Everyday Interaction,” in Proceedings of Less is More – Simple Computing in an Age of Complexity, Microsoft Research Cambridge, 2005 and David Bastien and Todd Hostager, “Cooperation as Communicative Accomplish-
ment: A Symbolic Interaction Analysis of an improvised


118. As compared to Fluxations, FluxNoisations is as yet at an less mature stage of development.


