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Latent State: a theoretical and practical study of Live Cinema

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Abstract

This work explores the practice of live cinema performance, which can be defined as the creation of audio-visual pieces where the recording, editing and projection/playback of the video and sound material is performed by the artist(s) in real-time in front of a live audience. This exploration was carried out in three complementary levels: a meta-level concerned with the narrative and audio-visual languages involved in this type of live performances, a technically-centered level that deals with issues of software architectures and interfaces suitable for real-time manipulation of video, audio and post-processing effects, and a more "practical" level which involves the entire process of creating a live cinema piece from the initial conceptualization to the final performance event.

Thematically, this work can be seen as a meditation on the collision of childhood fantasies with the harsher facts of the "adult" world, such as tragedy and death, within a highly mediated environment. Footage from the accident of the space shuttle Challenger on January 28th, 1986, intertwined with playful fantasies of space travel, supplies the raw visual and emotional substance for these meditations.

From a more technical standpoint, this piece has been created using new open source video and image filtering libraries for the Processing programming language. This libraries and other software components I implemented are part of an ongoing research on real-time audiovisual practices, particularly from the standpoint of performer-computer interfaces. The combination of high performance video capabilities with the ease of use and accessibility of Processing leads to an open-source framework where live cinema experiments can be carried out more freely.

Introduction

a. Conceptual motivations

This thesis work presents an artistic project that can be loosely located at the intersection between performance practice and real-time digital media. This project is not only about a specific piece, but also about the creation of an artistic identity and the development of a personal language of live performance. As an artistic research project, this work aims at connecting diverse theories and practices that can traced back to the late fifties, and were collective described by Gene Youngblood as "Expanded Cinema"[1]. The cinematic image, narrative structures and performative elements of the film form have been expanded (and then exploded) during the past fifty years by a multiplicity of new mediums and techniques: the use of computers and digital projections[2], real-time video sampling and mixing[3], experimental music and sound[4], multi-media performance[5], and more recently, interactivity and the cyberspace[6].

Some of the currents within the "expanded cinema" of the sixties and seventies have evolved into established forms and practices such as video art[7], visual-jockeying (VJ'ing)[8] and live cinema[9]. This project starts with many of the conventions of live cinema but, as its first goal, also looks to enrich the the experience of traditional live laptop performance by integrating physical materiality with real-time digital manipulations. But this integration at the same time exposes a fundamental divide between the physical and digital spaces: the later augments or expands the former, but without fully identifying with it. In the performances there is no attempt to create an illusion, but rather to accentuate the separation, and to remark the existence of a *perceptual in-between or liminal space.*

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1 Gene Youngblood, *Expanded Cinema* (New York : P. Dutton & Co., Inc., 1970), 75-8.
2 A. Michael Noll, "The digital computer as a creative medium" in *Cybernetic, Art and Ideas*, ed. Jasia Reichardt (Greenwich, Connecticut: New York Graphic Society Ltd, 1971), 143-64.
3 Timothy Jaeger, *VJ: Live Cinema Unraveled* (San Diego: University of California San Diego, 2005), http://nadassor.net/nonsite_files/livemedia_course/VJ_BOOK.pdf (accessed August 29, 2009), 15-7.
4 Stephen Crocker, "Sounds Complicated: What Sixties Audio Experiments Can Teach Us about the New Media Environments" in *Fluids Screens, Expanded Cinema*, ed. Janine Marchessault and Susan Lord (Toronto: University of Toronto Press, 2007), 52-73.
5 Günter Berghaus, *Avant-garde performance: Live Events and Electronic Technologies* (Hampshire, UK: Palgrave Macmillan, 2005), 179-235.
6 Berghaus, *Avant-garde performance*, 236-257.
7 Martha Rosler, "Sheeding The Utopian Moment" in *Illuminating Video, An Essential Guide to Video Art*, ed. Doug Hall and Sally Jo Fifer (New York: Aperture/BAVC, 1990).
8 Paul Spinrad, *The VJ Book* (Los Angeles: Feral House, 2005), 17-24.
9 Mia Makela, "Live Cinema: Language and Elements" (MA in New Media diss., Helsinki University of Art and Design, 2006), 22-4.

The second goal of this project is the creation of experimental software tools to carry out these experiences of live performance. Nowadays there are many applications available for laptop performance (Arkaos, Max/MSP/Jitter, VIDBOX, Resolume, Modul8, among others[10]), so the development of a new one calls for a justification, specially when speaking from the standpoint of the artist/performer. First of all, creating new tools opens the possibility for precise customization and adaptation an individual's aesthetic and expressive needs. Second, it allows for the exploration of new ideas and concepts without the constraints and restrictions of the paradigms embedded into pre-existing tools[11], and avoiding falling into the a so called "technophoria" that is problematic in terms of ceding control over meaning[12]   This is particularly important in the context of investigating the potential of new graphical interfaces for laptop-based performance[13]. Third, most of the real-time video performance tools are closed source, so making available the source code of the application developed during this research could be a useful contribution to the digital arts community.

b. Personal motivations

From a more personal standpoint, my interest in performance comes from perceiving performative practices as the activity that put me closer to a certain feeling of understanding, a momentary suspension of anxiety, criticism and doubt, an instant when things make "sense".

What these moments are, what this "something" is? As an preliminary answer, I can only give my own understanding of what an artwork could be: a particular assemblage of actions, objects and perceptions, which at first is no more than the sum of these elements, but then suddenly creates a metaphor that connects seemingly disparate feelings, ideas and thoughts in either the artist or the spectator (difference of roles which, by the way, I would like to become irrelevant: the roles of creation and perception mixing-up and coming back and forth).

This metaphor is fleeting, and could happen only once: there might be one and only one moment in time when the collection of elements the artwork physically is and the rest of the world

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10 Xárene Eskandar, ed., *vE-jA: Art + Technology of Live Audio/Video (*San Francisco: h4, 2006), 8-15.
11 René Beekman, "Composing Images", *Lier en Boog Series of Philosophy of Art and Art Theory*, Volume 15: Screen-Based Art (1999), http://www.xs4all.nl/~rbeekman/l&b.html.
12 Randy Jones, "New Eyes for the Mind" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 126.
13 Jay David Bolter and Diane Gromala, *Windows and Mirrors: Interaction Design, Digital Art and the Myth of Transparency* (Cambridge: The MIT Press, 2003), 40-56.

around it create the metaphor. And yet I would say that the artwork is successful, even though it is no more than just a pile of objects in the storage room, or a collection of pictures or videos on the web, once the "metaphor-moment" is gone.

My artistic experience so far has led me to identify a number of concepts, processes and methods that for me are the most adequate to create these metaphor-moments: performance, chance, uniqueness, chaos, spontaneity, gesture. The search starts by making an unexpected gesture, a unique performance guided by chance and spontaneity, even a free fall into unknown and unexpected experiences. This is my base material: bits and pieces of actions and events, which can be then reconnected and assembled together, to create a new narrations and metaphors.

The interest in collage stems from the following observation: that our memory puts chance events together into a certain narrative. We look at our past, do everyday activities, look at an artwork, and we put things together, creating a history that connects these elements with our image of the present. There is an opposition and balance between chance and control, a constant interplay that has been permeating into my artistic interests and practice.

My practice also reflects this opposition between chance and control not only because of the practices and modes of operation I am setting to explore (performance, spontaneity, etc.) but also because of the medium I am using. As a media artist I see digital technology in general and computer programming in particular as the ultimate case of control: a computer process has to be specified down to the minutest detail and without any ambiguity in order to function properly. Computers were first created to calculate accurate simulations of the trajectory of missiles. Perhaps an outdated example, but valid as a metaphor nonetheless. However, computers also allow for the unexpected and for chance: interactivity and networks show this, and maybe in ways never imagined before. Again, the interplay between control and chance is at work.

I see my own artistic current practice and project developing in a two-modal process where skilled choices and chance gestures confront and dialog to each other. I think that precisely at the interstices between causal and casual is where the "metaphor-moments" take place.

As my current artistic practice is rooted in this control-chance confrontation which can traced back to archetypical structures embedded in our psyche during the growing-up process, I feel the necessity to explore themes that parallel this binary opposition and refer to childhood memories and perceptions. Re-enacting fantasies of space travel from the perspective of a child and replaying

memories of highly mediated tragic events which affected the transformation of these fantasies into adult, rationalized thinking allowed me to construct a space to transition between playfulness and seriousness, transcendental and trivial, tragic and humorous.

c. Thesis organization

The thesis is divided in two major sections, Theory and Practice, one Appendix, plus a final Conclusion. The Theory section deals with the artistic and conceptual antecedents for this work, mainly in the context of experimental performance, live cinema and open source. The Practice section describes in detail the creative processes and final outcome of the performance pieces carried out as part of the MFA thesis exhibition - one at UCLA's Experimental Digital Arts (EDA) space and another at the Museum of Jurassic Technology - as well as the personal background that motivated their creation.

The final Appendix section serves as a reference for the custom software tool specifically developed for these series of performances, called Andiamo, and the related libraries I programmed to achieve real-time video playback and filter effects in Processing.

Part 1: Theory. Conceptual and historical antecedents

1.1 Artists as tool creators, tools as extensions of the artist

As a live performer who develops his own software tools for real-time interpretation, I find the relationship between tool creation and artistic practice to have a major importance in my work. The distinction between the artwork and the tool or device used to create it already becomes problematic in the larger context of the Media Arts. This ambiguity appears more clearly when the artist creates her own devices or machines for performance and interaction. If these devices take the form of bodily extension to enhance certain activities or to modify modes of perception, then they have a message of their own about our physical and perceptual abilities and limitations. Rebecca Horn's performance/body modifications pieces are far away from the context of software art, but nonetheless they point out clearly to the concept of the art piece as a body (and mind) extension [14].

More directly related to digital audiovisual performance is the lady's glove built by Laetitia Sonami[15]. The lady's glove is a tool that provides new performative possibilities to the artist. Since it was created and built by the artist herself, it is perfectly customized and adapted to her expressive intentions. The first iteration was made with rubber kitchen gloves, and this sole fact conveys additional meaning to the piece.

Device art, particularly important in Japan[16], also questions how the artistic experience is labeled and where is located: is it in the event that takes place when using the artifacts, in the subsequent documentation, or in the devices themselves? These devices are clearly not just means to an end, either when they are nonsensical or deeply critical (and perhaps even more so in these extremes), as the work from Maywa Denki[17] shows. However, the other aspects of the experience (performance, documentation, etc.) also claim some part of the prize.

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14 Lea Vergine, *Body Art and Performance: The Body as Language* (Milan: Skira Editore, 2000), 114-7.
15 Media Art Net, "Sonami, Laetitia: Lady's Glove", http://www.mediaartnet.org/works/ladys-glove/ (accessed August 29, 2009).
16 Machiko Kusahara, "Device Art: A New Form of Media Art from a Japanese Perspective", *Intelligent Agent* 6, num. 2 (2006), http://www.intelligentagent.com/archive/Vol6_No2_pacific_rim_kusahara.htm (accessed August 29, 2009).
17 *The nonsense machine exhibition catalog* (Tokyo: NTT InterCommunication Center, 2004).

Illustration 1: Rebecca Horn's (left), Laetitia Sonami's (center) and Maywa Denki's (right) bodily extensions for performance.

These three references (Rebecca Horn's bodily extensions, Laetitia Sonami's gloves and Japanese device art, see Illustration 1), although relatively removed from live audiovisual performance (and even more specifically, "laptop" performance), illustrate three characteristics that make difficult the separation between tool and artwork in Media Arts in general: extension of the artist's capabilities, customization (do-it-yourself culture) and significant focus on the medium or technology itself.

In the context of laptop audiovisual performance, these three features are somewhat obscured by the widespread presence of personal computers (and the subsequent unawareness of the multiple extensions that these technologies bring to our perceptions), the utilization of prepackaged software tools and implicit acceptance of their conventions, and some lack of self-reflection by the hacker/artist. The creation of complex algorithmic mechanisms or tools has the risk of trapping the toolmaker in the beauty that results purely from the system's internal logic and self-coherence. However, many VJ artists who create their own custom tools, such as OVT visuals[18], DeKam (Johnny DeKam)[19] and Solu (Mia Makela)[20] and Lia[21] exemplify how the capability of coding-up precisely tailored audiovisual performance tools give the artist/programmer an unparalleled flexibility and the possibility of achieving highly personal artistic styles and unique artworks. Widely used programming languages and frameworks such as MAX/Jitter, PureData, Processing, Flash, Wiring/Arduino and others encourage

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18 Xárene Eskandar, ed., *vE-jA: Art + Technology of Live Audio/Video (*San Francisco: h4, 2006), 63.
19 Eskandar, *vE-jA*, 67.
20 Eskandar, *vE-jA*, 97.
21 Eskandar, *vE-jA*, 122.

personal experimentation and creation of artistic tools.

Illustration 2: Solu's Nine live AV performance.

Do-it-yourself (DIY) experimentation has been present in the area of electronics visual arts for decades, consider as an example of this statement machines for video manipulation such as the Direct Video Synthesizer created by Stephen Beck in the early 70s[22]. This fact places the custom creation of tools for digital art within the larger context of the DIY culture, from which the Make magazine represents a widely known exponent[23], with its emphasis in the utilization of off-the-self components, customized solutions and sharing of knowledge and experiences among the member of the community devoted to the particular artistic/creative/engineering practice. In the specific context of software tools, the movements of open source and creative commons are particularly relevant, and are discussed in the next section

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22 Media Art Net, "Beck, Stephen: Direct Video Synthesizer: Zero and One", http://www.mediaartnet.org/works/direct-video-synthesizer/ (accessed August 29, 2009).
23 makezine.com, "MAKE: technology on your time", http://makezine.com/ (accessed August 29, 2009).

1.2 Open source, open experimentation

The - generally - non-commercial nature of experimental computer arts and a strong sense of community has fostered the sharing of experiences, techniques and resources between their practitioners among the "hacker class"[24]. This sharing, communal mindset provides a fertile ground for the acceptance of Open Source coding approaches, which were originally introduced in more technical, application-driven contexts of software development. The Open Source development model has grown dramatically in the last decade, fostered by the success of well-known projects such as Linux and Firefox. Eric Raymond used the term *Bazaar style* in his 1997 essay The Cathedral and the Bazaar[25] to describe a development process where not only the source code is publicly available, but the process itself is open to the scrutiny of other developers and even end users. The two basic premises of the bazaar model: "release early, release often", and "given enough eyeballs, all bugs are shallow", are essential to the idea of continuous and open public testing, scrutiny, and experimentation.

In the relation to my own artistic project, I find open source development as methodologically and ideologically consistent with a way of working based on community collaboration and knowledge sharing. It also resonates with the some of the concepts behind the DIY movement. There are numerous artistic tools and works which are released along open source licenses, among which we can mention Pure Data[26] by Miller Puckette, openFrameworks[27] by Zachary Lieberman *et. al.*, and Processing[28] by Ben Fry *et. al*. The website runme.org[29] provides a very comprehensive database of software art projects, many of them made available together with their source code and some form of open source license. The GNU Public License (GPL) is a widespread OSS (Open Source Software) license although not the only one. There are in fact many OSS licenses[30], some more permissive than the GPL, some other more restrictive. There is even a license explicitly called the "Artistic License"[31] which provides more flexibility to the developers at the moment to re-use preexisting code and combine it with their own.

24 McKenzie Wark, *A Hacker Manifesto* (Cambridge: Harvard University Press, 2004), 205.
25 Eric Steven Raymond, "The Cathedral and the Bazaar", Thyrsus Enterprises, http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/ (accessed August 29, 2009).
26 Miller Puckette, "Software by Miller Puckette", University of California San Diego, http://crca.ucsd.edu/~msp/software.html (accessed August 29, 2009).
27 openFrameworks, http://www.openframeworks.cc/ (accessed August 29, 2009).
28 Processing, http://processing.org/ (accessed August 29, 2009).
29 runme.org, http://runme.org/ (accessed August 29, 2009).
30 Open Source Initiative, http://opensource.org/ (accessed August 29, 2009).
31 Open Source Artistic Licenses, http://opensource.org/licenses/artistic-license.php (accessed August 29, 2009).

Open source development does not necessarily equate with the bazaar model, although many open source projects adopted the bazaar style after the influential Raymond's publication and Linux's success. In the context of software art, it can be argued that for most projects this model wouldn't be productive, and even feasible, since the bazaar model assumes a large number of users that can contribute to the development and debugging process. Most of software art is very specific in its purpose, applications and even its audience. However, in the case of a software piece that can be also regarded as a tool in a more general sense, bazaar development techniques could be potentially useful given the potentially larger user base. The existence of active online communities around projects such as Processing[32] and openFrameworks[33] is an evidence of this fact, although these software projects are at one end of the spectrum ranging from specific to general tools.

There are two difficulties in the digital arts that can solved by relying on open source: limited programming practices, and prevalence of outdated software paradigms. The first issue is mentioned by artist/programmer Alex Mclean in an interview[34] by Olga Goriunova and Alexei Shulgin from runme.org:

> *"...making code is empowering, but generally taught very badly. The act of programming is portrayed as systematic and uncreative. This may be appropriate for working on quality assured credit card transaction systems, but why apply it to programming as a whole? Software art might give us a place to look at the creation and use of software outside of formal business constraints, and the stereotypes thereby fostered."*

Often times programming is regarded as a purely engineering work carried over to solve a specific problem with a predetermined outcome. This approach arguably translates into a perception of programming in the arts as only a way of mimicking, simulating or emulating "true" artistic mediums or techniques. Programming, in this view, is just the technical "black magic" that makes possible "analog" creativity supported by the digital computer. In the specific context of image and video editing tools, the following excerpt from an essay[35] by René Beekman is very relevant for this discussion:

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32 Processing discourse, http://processing.org/discourse/yabb2/YaBB.pl (accessed August 29, 2009).
33 openFrameworks forums, http://www.openframeworks.cc/forum/ (accessed August 29, 2009).
34 Olga Goriunova, Alexei Shulgin, et al., *QuickView on Software Art*, http://art.runme.org/1046615440-32394-0/runme_interview.htm (accessed August 29, 2009).
35 René Beekman, "Composing Images", *Lier en Boog Series of Philosophy of Art and Art Theory*, Volume 15: Screen-Based Art (1999), http://www.xs4all.nl/~rbeekman/l&b.html.

"Most computer software currently in use by visual artists employ interface metaphors based on analog,real world predecessors. In Photoshop, for example, the screen area where one paints is still called a canvas and painting itself is still done with brushes and pencils that replicate real world brush and pencil prints. For years there has been a war among different software companies for who could write the best plugin for charcoal with the sole purpose of replacing real world charcoal [...] The implications of Marshall McLuhan's statement, "First we shape our tools, thereafter they shape us", seems to have become all too clear."

Open source development practices bring the coding or "hacking" activities to a substantially more relevant position, and fosters the communal and social component of software creation. Hundreds of code snippets are posted, shared and discussed at online forums such the ones mentioned earlier and many others (openProcessing[36], Pure Data[37]). This undoubtedly stimulates experimentation (people are eager to show their new findings to other community members), knowledge accumulation (these forums and other online resources represent a large wealth of information fully available for artists and programmers all over the world) and progressive refinement of ideas and methods (a small piece of code exemplifying a new technique or effect is picked up and improved by other artists).

As Christopher M. Kelty concludes in his book "Two Bits: The cultural Significance of Free Software"[38]:

"Every day, from here to there, new projects and ideas and tools and goals emerge everywhere out of the practices that I trace through Free Software: Connexions and Creative Commons, open access, Open Source synthetic biology, free culture, access to knowledge (a2k), open cola, open movies, science commons, open business, Open Source yoga, Open Source democracy, open educational resources, the One Laptop Per Child project, to say nothing of the proliferation of wikieverything or the "peer production" of scientific data or consumer services—all new responses to a widely felt reorientation of knowledge and power."

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36 OpenProcessing, http://openprocessing.org/ (accessed August 29, 2009).
37 Pure Data forums, http://puredata.hurleur.com/ (accessed August 29, 2009).
38 Christopher M. Kelty, *Two Bits, The Cultural Significance of Free Software* (Durham: Duke University Press 2008), 301.

Before moving on to the subsequent sections where the subject of live cinema and audiovisual performance is explored in detail, I would like to finish these initial discussions on open source and software arts and tools by noting that all the coding work done in the context of this thesis would have been impossible without the resources, code and collective experience freely available online.

1.3 The elements of live laptop-based performance

Audiovisual (AV) laptop performance has matured during the past ten years or so into a well defined art practice with a set of conventions and boundaries. Mia Makela (a.k.a Solu), a practitioner of live cinema based in Barcelona, identifies in live laptop-based performance the following basic elements[39]:

1. Space, in other words, the location where the performance occurs, shared between the public and the performer.
2. Time, since AV performance is an event that takes place in a specific moment in time and has a certain duration.
3. Performer, who operates the computer (and other instruments as well) in order to create the images and sounds that define the performance.
4. Projection, defined as the area(s) used to display the images as well as the means of projecting these images.
5. Public, meaning the audience that participates in the performance event (and affect it development by its own presence and sometimes by explicit participation).

These elements are very broad and provide a general framework where to situate very different types of digital audiovisual practices and methodologies. There is another element that should also be added to this list, which is the "digital audiovisual substance" that Golan Levin refers to in his MS thesis[40]. Levin considers this "substance" in the specific context of his own work with painterly

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39 Mia Makela, "Live Cinema: Language and Elements" (MA in New Media diss., Helsinki University of Art and Design, 2006), 23.
40 Golan Levin, "Painterly Interfaces for Audiovisual Performance" (MS in Media Arts and Sciences diss., Massachusetts Institute of Technology, 2000), 53-8.

interfaces for live performance:

> *"I introduce a new interface paradigm for audiovisual performance instruments. This metaphor is based on the idea of an inexhaustible, extremely variable, dynamic, audiovisual substance which can be freely "painted," manipulated and deleted in a free-form, nondiagrammatic context. According to this scheme, a user creates gestural, painterly marks in a two-dimensional input field, using an electronic drawing device such as a Wacom tablet or mouse. These marks are treated as the input to digital signal analysis algorithms, filtering algorithms, and computer simulations. The outputs of these algorithms are then visually interpreted by a graphics synthesizer, and also sonified by an audio synthesizer."*

For matters of convenience, from now on I'll refer to this "digital audiovisual substance" just as *AV-substance*.
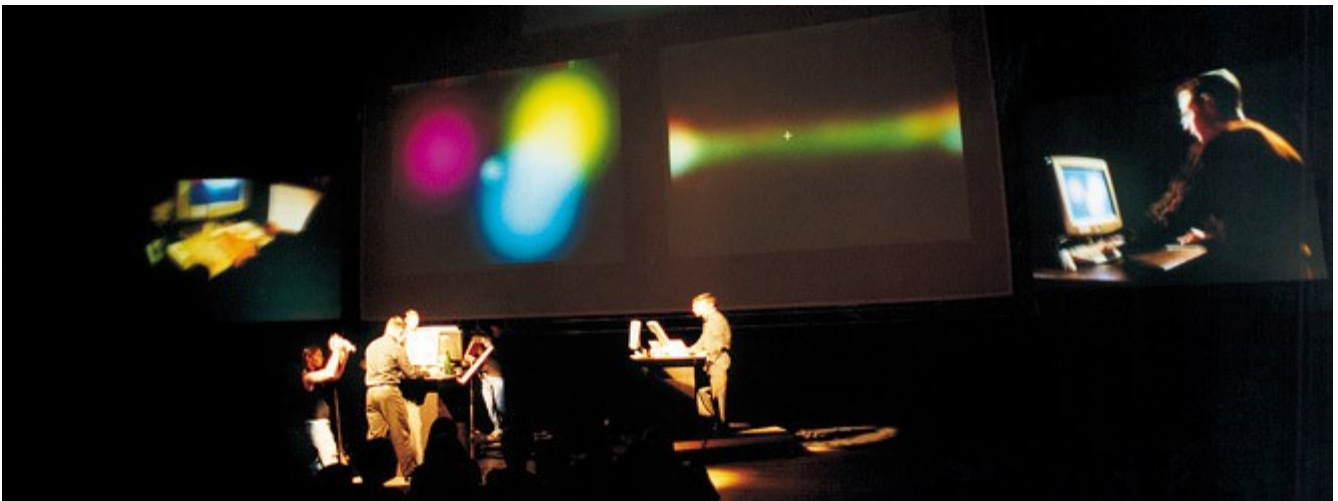
Illustration 3: Scribble, live audiovisual concert by Golan Levin, Gregory Shakar and Scott Gibbons.

The concept of a digital AV-substance could arguably be extended to all varieties of laptop-based digital performance. This substance is, ultimately, the signal processed by the computer in different ways at each single moment during the execution of the software tool used by the performer. This stream can originate from a video file, a live feed from a camera or by a generative algorithm, just to mention a few possible sources. But irrespective of the source, the stream can be reinterpreted and reprocessed an infinite number of times. Understanding bits as pixels allows to compose multiple

layers of image-processing kernels on top of a source video stream. The result can be entirely unrecognizable, and nevertheless is made of the same substance (which can be further modified or "typed-casted" under a different representation) as the original video. Digital computers are physical realizations of Universal Turing machines, and therefore by changing the transcoding algorithm, the meaning of the bits change accordingly, even to the point of converting data into instructions. It is interesting to note that this equivalence of data and instructions is one of the features of digital computers most commonly exploited by malicious software by means of the so-called "buffer overflow" errors[41].

However, after all these changes and transformations, the AV-substance remains in digital space, even when projected onto the physical world. The projection is "harmless" and "safe" since it is completely contained and bounded inside the computer. We do manipulate this substance, but only from the "outside", and even if we also control its analog or physical sources (live video for instance), once they are converted into digital substance, they are in a way out of reach. There is a division between the physical or analog space and the digital plane. The public can be surprised, amazed or disgusted by the projected image, but they know it is just the result of a process taking place inside the computer, just a synthetic simulacra[42], a casting, literally a projection, of recycled forms onto pre-existing physical shapes[43].

The role of the live performer needs to be discussed here, since the last paragraph seems to be ignoring her altogether. This is a delicate issue, in fact, and it relates to the question: "how does the public know that what they see is either a truly live visual performance or just a DVD playing a movie?". Some visual performers stress the live characteristic of their act by adding a second screen or projection showing him or her operating the laptop[44]. Perhaps it can argued that a live performance succeeds as such (and not just as a visual piece) when there is no need to stress its "liveness", when the public "connects" with the performer in such a way that there is something else that doesn't exist entirely inside the computer, nor it is completely outside of the digital domain [45]. Besides the basic six elements that constitute a digital audiovisual performance (the first five pointed out by Mia Makela,

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41 Wikipedia ed., "Buffer overflow" *English Wikipedia* , http://en.wikipedia.org/wiki/Buffer_overflow (accessed August 29, 2009).
42 Steve Dixon, *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* (Cambridge: The MIT Press, 2007), 143.
43 Dieter Daniels, "The Bauhaus as Projection" in *Bauhausblock*, ed. Lutz Schöbe (Bauhaus Dessau & Edition Cantz Ostfildern, 1992) 101-5.
44 Dixon, *Digital Performance*, 46.
45 Dixon, *Digital Performance*, 129.

with the sixth being Levin's AV-substance), I suggest an additional element that crosses the boundaries between the digital and analog (physical) and exists in the perceptual space in between all the other elements discussed so far: a *perceptual in-between or liminal space* (*L-space* for short).

I argue that the success of the performance as a live event, unique in time and space that exists outside the safety of the purely digital realm is contingent to the presence of this liminal element. It can be generated within the boundaries of "conventional" audiovisual practice such as VJ'ing, but doing so requires a talented performer able to create an in-between perceptual space and to break the boundaries of the genre from within its own accepted conventions. The performative skills of the artist alone are able to break the separation between the plane of the digital image, the space of the physical bodies and the sphere of subjective perception of the audience. Mastery of the digital tools can allow the artist to represent her "analog" internal vision[46]. But I will also argue that this liminal element can be introduced in a more explicit way, by creating highly intertwined relational systems between the real/analog space and the digital plane. The intent of this approach is not to replace the skilled/talented laptop performer by an automatic system, but to point out possible ways in which the boundaries of the live audiovisual performance practice could (and are) being expanded.

The following scenarios could point out to the *in-between-ness* nature of this liminal perceptual space:

1. Party-goers discover that the colorful shapes projected onto their bodies while in the dance floor respond to their motions. This realization prompt them to play with these shapes, digitally attached to their physical bodies;

2. an audience performs with an interactive art piece that digitally augments their hands by projecting puppets that are controlled by their gestures. While these actions take place simultaneously in the real, "analog", space, the digital image space (projection) and process space (computer memory, capture devices, etc), the resulting experience has a "tangibility" that escapes these three independent planes considered in isolation.

At this point, the following question arises: what kinds of arrangements between analog/physical and digital/simulated elements in a live performance piece successfully generate this L-space? One approach consists in hiding the (digital) framework in order to accentuate the perception of the digital image as a "magic" occurrence. As an example of this approach, we can take the installation

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46 Randy Jones, "New Eyes for the Mind" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 123.

piece "3 minutes²" by the French art group Electronic Shadow:

> *"3 minutes²" (2004) is an installation mixing space and image, real and virtual and proposes a hybrid habitat metamorphosing endlessly around it is inhabitant. No screens, no visible interfaces, the two characters touch the walls, make movements, the habitation responds to them. The technology has become totally invisible and the effect of technology becomes then magic. ..Parallel realities melt in one space-time, 3minutes are a space, 10 square meters are a space. 3 minutes² is a surface-time, a hybrid space living according to it is inhabitant's rhythm, his trace, his electronic shadow."[47]*

The applications of real-time audiovisual digital media in theater often lie in a gradation within two extremes: on the one hand, hiding the digital to create "analog" illusions (take for instance George Coates productions[48]) and, on the other hand, a more critical and explicit (even Brechtian) use of technology and digital media, exemplified very clearly by the pieces from New York company Builders Association[49]. Located between these two extremes, we can find more "traditional" theatrical approaches[50] where the combination of projected cinematic image, multiplicity of video screens, non-conventional stage lighting and, more recently, sophisticated setups with live feedback and interactivity create new narrative possibilities. This type of work was pioneered by Josef Svoboda with Laterna Magika during the 50s and 60s[51], and it is epitomized today by the productions of The Wooster Group[52].

On the opposite end of the spectrum with regards to the way technology is shown (or not shown) and its relationship with the actual content of the piece (the technology is the message, to paraphrase Marshall MacLuhan[53,54], once again), we find works such as the series of performance pieces by film maker Pierre Hébert and composer Bob Ostertag, "Living Cinema"[55]:

> *"Although technologically intensive, Living Cinema does not celebrate technology but questions it, and its relation to the bodies of performers and the world around us, and, of*

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47 3 Minutes², "Window on a Hybrid Life Space" http://www.electronicshadow.com/3mn/textEN.htm (accessed August 29, 2009).

48 Dixon, *Digital Performance*, 338.

49 Dixon, *Digital Performance*, 343.

50 Dixon, *Digital Performance*, 351.

51 Vit Havrenek, "Laterna Magika, Polyekran, Kinoautomat", in *Future Cinema: The Cinematic Imaginary after Film*, ed. Jeffrey Shaw and Peter Weibel. (Cambridge: The MIT press, 2003), 102-9.

52 Dixon, *Digital Performance*, 105.

53 McLuhan, Marshall, *Understanding Media: The Extensions of Man* (Berkeley: Gingko Press, 2003), 19-35.

54 Mark Federman , "What is the Meaning of The Medium is the Message?", http://individual.utoronto.ca/markfederman/article_mediumisthemessage.htm (accessed August 29, 2009).

55 Bob Ostertag homepage, http://bobostertag.com/music-liveprojects-livingcinema.htm (accessed August 29, 2009).

course, garbage. Today's cutting edge technology is of course tomorrow's garbage. This paradox is not banished to the shadows as an unspoken embarrassment, but is rather the starting point of the entire project. Ostertag and Hébert sit on stage and try to sense out of science and garbage — a more explicit rendition of the situation we all live in every day."

To refer to MacLuhan once again, and maybe in a more thoughtful way, we can ask ourselves what is the old medium that live audiovisual performance is encapsulating. Film appears to be the most immediate answer, specially if we think of the remixing and live editing of VJ'ing.

The use of multiple media sources, and in particular "traditional" media such as paint, watercolor, crayons, as well as physical devices and materials (machines, found objects, etc), is a direction already adopted by many artists, such as the collective AVCENTRALEN[56], video artist Sue-C[57] and media artist Julien Maire[58]. Takashi Kawashima's live shadow puppet/video performance "Takashi's Seasons"[59], where digital projections interact in real-time with traditional Utsushi-e puppets, is a very poignant example of this multiplicity of media and how new perceptual spaces are created at the interstices between the digital and the analog.

Illustration 4: Still from Sue-C's "Live at the Lab" (left), Julien Maire's "Demi-pas" (right).

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56 AVCENTRALEN homepage, http://www.avcentralen.net/ (accessed August 29, 2009).
57 Sue-C homepage, http://www.sue-c.net/ (accessed August 29, 2009).
58 Julien Maire homepage, http://julienmaire.ideenshop.net/ (accessed August 29, 2009).
59 Takashi's Seasons, http://portfolio.takashikawashima.com/#55962 (accessed September 1, 2009).

The previous examples aimed at making the idea of a liminal region between the digital and the analog spaces more concrete. I propose that this space is what makes a live AV laptop performance bigger than the sum of its parts. The concept of "liminal spaces" has been proposed earlier in the context of theater[60], and the following quotation illustrates the idea of liminality quite well:

"The conjunction of live performance and digital imaginery can produce a particular, hybrid form and experience akin to what Alain Virmaux has described in relation to Artaud's film scenarios: "something which is neither theatre nor film, but partakes of the evanescent reality of dreams." This sense of in-between-ness - a liminal space operating between the screen images and live performers- is often the essential kernel, what one might even call the "metatext" of digital theater production. Margaret Morse, Elizabeth Grosz and Sarah Rubidge have each argued that the idea of the space "in between" is central to the artistic forms and spectator experiences of (respectively) video installations, architecture and immersive artworks. What is fundamental is not so much the material object or environment, but rather the space it occupies and the dynamic spaces configured and experienced by visitors and spectators in relation to it. As we will see, this also holds true for digital theater spectacles, where the stage space becomes transitional, always in a state of flux, and, in Elizabeth Grosz words, "always in the process of becoming but never realized… the space of the in-between."

After these considerations regarding the elements that define a live AV performance piece, I would like to extend the original list suggested by Mia Makela with these two new elements just described (AV-substance and L-space) in order to propose the following list :

1. (analog)space
2. (real)time
3. performer
4. screen
5. audience
6. (digital)AV-substance
7. L-space

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60 Dixon, *Digital Performance*, p. 337

The L-space is intangible, and even though it fills the gap between the projected digital AV-substance and the analog/physical elements of the performance, it does so within the audience's perceptual level. Narrative is also a perceptual construction, hence the L-space and the "illusion" of narrative are placed at neighboring, although not identical, locations in the spectator's mind. Next sections will explore the issues of narrative and the nature of the analog/digital interstices in terms of a proposed dichotomy: *open versus closed liminality.*

1.4 Spacial narrative in Live Cinema

Live cinema performance, as a relatively young artistic practice, poses new questions and defies existing conventions. One of such questions is how the concept of narrative can be translated into the context of live audio-visual performance. Artists such as Solu argue that live cinema breaks free from the requirements of narrative storytelling in order to create purely audiovisual experiences. According to Solu[61], one of the goals of live cinema is to evoke feelings and sensations in the audience, without the need of traditional film devices like linear storytelling and dialog, but by means of the live, non-linear manipulation (editing, mixing and filtering) of visual and audio material. In this conception of live cinema, audiovisual abstraction, synaesthetic perception[62] and subjective representations[63] become very important, if not the most significant, means of narrative expression.

This idea of purely audiovisual - even multisensorial and synaesthetic - experiences has many antecedents that can be traced back to the Absolute Film movement in Germany in the 1920s, represented by artists like Walter Ruttmann[64]. "Visual music"[65] devices such as Thomas Wilfred's Clavilux and Oskar Fischinger's Lumigraph[66] are regarded today as early antecedents of abstract

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61 Mia Makela, "Live Cinema: Language and Elements" (MA in New Media diss., Helsinki University of Art and Design, 2006), 53-4.
62 Jan Schacher, "Live Audiovisual Performance as Cinema Practice" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 148-9.
63 Randy Jones, "New Eyes for the Mind" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 122-3.
64 A. L. Rees, *A History of Experimental Film and Video* (London: British Film Institute publishing, 1999) 37-40.
65 Tom DeWitt, "Visual Music: Searching for an Aesthetic", *LEONARDO 20*, nro. 2 (1987) 15-122.
66 Golan Levin, "Painterly Interfaces for Audiovisual Performance" (MS in Media Arts and Sciences diss., Massachusetts Institute of Technology, 2000), 21-8.

cinematic image. Work from Mark Adrian[67] in Europe, the Whitney brothers[68] in the United States, British experimental video art (Malcolm Le Grice, Tony Conrad, Bruce Conner [69]), Kenneth Anger[70] and the Vasulkas[71] pioneered the exploration and questioning of different aspects of the film practice, some related to the narrative and semiotic codes of the medium, others concerning the visual and cinematic devices. The questions posed by live cinema today, by the end of the first decade of the 21st century, might well be just a transposition of the questions posed 30 or 40 years ago. But at the same time, this questioning occur in an environment where audiences are familiar with hyper-textual narratives and non-linear, networked structures, and where the screen is ubiquitous at the individual scale.

Even in an entirely abstract audiovisual piece, the audience will construct some kind of narrative, since it is a natural tendency of our brains to make sense and build stories out of the information we apprehend in any situation. So perhaps is not a question or whether or not live cinema goal is to create a narrative or a story, but how the specificity of live digital performance extend the notion of narrative, specially in relation with the highly mediated and hyper linked environments we live in today. In particular, something as basic in traditional storytelling such as the existence of a definite beginning and end need to be evaluated under the light of these factors.

Timothy Jaeger writes in his book "VJ: Live Cinema Unraveled" about the idea of mixing and filtering as narrative: *"The narrative and dynamics of rhythm in the mix becomes the narrative of the performance itself"[72]*. Perhaps in a hyper linked world where we jump from one story to another with ease, or keep multiple stories going on in parallel, the overall narrative is defined not so much by the content of each individual story, clip or loop, but by the networked structure that results from mixing these stories together.

Lev Manovich[73] refers to spatial composition as the montage approach preferred and facilitated by audiovisual software tools. In this sense, hyper linked stories (as well as multiplicity of screens) lead to narratives that are not necessarily developed (only) in time, but are "instantaneous" in

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67 Peter Weibel, "Expanded Cinema, Video and Virtual Environments", in *Future Cinema: The Cinematic Imaginary after Film*, ed. Jeffrey Shaw and Peter Weibel. (Cambridge: The MIT press, 2003), 124.
68 Gene Youngblood, *Expanded Cinema* (New York : P. Dutton & Co., Inc., 1970), 207-46.
69 Rees, *A History*, 77-93.
70 Makela. *Live Cinema*, 20.
71 Woody Vasulka, "The New Epistemic Space", in *Illuminating Video, An Essential Guide to Video Art*, ed. Doug Hall and Sally Jo Fifer (New York: Aperture/BAVC, 1990) 465-70.
72 Timothy Jaeger, *VJ: Live Cinema Unraveled* (San Diego: University of California San Diego, 2005), http://nadassor.net/nonsite_files/livemedia_course/VJ_BOOK.pdf (accessed August 29, 2009),16.
73 Lev Manovich, *The Language of New Media* (Cambridge: The MIT press, 2001), 155-61.

presentation and extended over space. The construction of meaning by the audience is a gradual process that depends on navigating these spacial networked structures, available all at once for sensory capture. Now, if we think of each screen and link containing a pre-digital, time-composed fragment (video clip, animation), we can refer once again to MacLuhan's analysis of new media containing the old. In this case, live cinema contains old, non-live, cinematic material. Audiences might focus, at least at first, in the old content, this is, in the animation clips, movie fragments, etc. However, as society becomes progressively more influenced at the every day level by visual fragmentation, instantaneous communication and networked patterns, the "spacial" narrative approaches of live cinema move from anticipation of the things to come to real-time re-presentation of the current modes of media consumption and interpretation.

The issue of narrative in the post-digital word is explored by multiplicity of approaches, besides the spacial montage discussed in the previous paragraph: glitch aesthetics[74], embodied image[75], mixed media and inter-media[76,77], etc. In the next section, the idea of liminality and in-between-ness will be further explored in relation to the construction of meaning by the audience, by discussing the contradiction of open versus closed liminality.

1.5 Open and closed liminality: the contradiction of Live Cinema

In earlier sections, the idea of liminal spaces was introduced in the context of audiovisual laptop performance and Multimedia Theater. The liminal space is characterized by the property of *in-between-ness*: it occupies the interstices separating self-sufficient entities building up a larger system, while at the same time being outside the system by virtue of its *permanent becoming*[78]. In the case of AV performance and Theater, these entities are the analog and the digital. In concrete words: the physical

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74 Kim Cascone, "The Aesthetics of Failure: 'Post-Digital' Tendencies in Contemporary Computer Music", *Computer Music Journal 24*, nro. 4 (2000), 12-8.
75 John Richards, "32kg: Performance Systems for a Post-Digital Age", *Proceedings of the 2006 International Conference on New Interfaces for Musical Expression* (2006), 285.
76 Steve Dixon, *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* (Cambridge: The MIT Press, 2007), 89.
77 Gene Youngblood, *Expanded Cinema* (New York : P. Dutton & Co., Inc., 1970), 346-51.
78 Dixon, *Digital Performance*, 337.

space of the stage and objects and bodies contained in it, and the screen space. Screen space is, however, an abstraction, a metaphor: the screen as a representation of the digital, a window into the digital, algorithmic space, or a projection of the digital onto the supporting physical space.

Our perception sees the digital projecting onto the physical, trying to become part of it. But we know that they are not the same (even though some artists look for the magician's trick, fooling the senses with a temporary illusion of a new fused, united space), and in a way they are impossible to reconcile. There is a perceptual gap or interstice that is inhabited by the dialogical exchange between the bodies and the images. The in-between-ness is not physical (after all, the pixels do exist physically as light being absorbed and reflected by the skin's atoms), but dialectical and perceptual.

This situation it also has a *directionality*: first, sensors capture the motions and activities of the performers on the stage. Second, this information is digitalized and converted into specific data structures in the computer's memory, amenable of algorithmic treatment. The results of these operations inside the computer are digital packets of information: pixels, audio samples, maybe discrete current pulses that control the motion of a mechanical device. Irrespective of the specific nature of the digital information, it is "projected" (here the word has a more general meaning than just light projection) back onto the original space: the stage, the performers, even the audience. In other words, the in-betwen-ness takes place in a closed circle. Information starts and ends in the same physical space, where the superposition of the digital and the analog (and its impossible reconciliation) creates the dialogical interface between the two:

How this idea of the space in between translates in the context of live cinema? The live situation, as in the Digital Theater, provides the physical layer that is part of the audiences' perception. But the interaction with the digital is different. In a first instance, there might not be interaction at all: the screen space is completely detached from the physical space. The projected content comes exclusively from the information stored inside the computer: video, audio, generative graphics, etc. There is no dialog between the (actual) analog and the digital, except inside the performer's head, where the mental process of live operation takes place.

A second instance introduces a digitalization of physical objects, contraptions, machines (performance devices). A very straightforward digitalization: a live camera capture of these performance devices or contraptions. They move, change, react, autonomously or controlled by the performer. They constitute a micro-stage, and then the cinematographic, planar, screen shows them,

perhaps mixed with other elements. However, the micro-stage is not hidden from the audience. This is not a minor point, in fact it is central to the appearance of a new gap, a new divide, a new liminal space. This time, the perception is disjointed: the physical objects on one side, their digitalized projection on the other. Now the in-between-ness occurs physically as well as perceptually.

As Randy Jones points out in his essay "New Eyes for the Mind"[79], live cinema is based on a (vital) contradiction: while live means situated (the performer is in a specific space and time together with the audience witnessing her actions), cinema means a-situated (we engage ourselves as movie audience with another space through the screen and loose contact with the physical surroundings). It is precisely the open liminality of live cinema what generates this contradiction by defining two separate spaces: the a-situated screen and the situated stage. Open liminality defines a tension between these two conditions from which live cinema practitioners can extract unique narrative possibilities by navigating the in-between space that separates the physicality of presence from the cinematic codes of the digital image.

1.6 Live drawing, live process

Besides the vital contradictions between situated and a-situated, open and closed liminality, the unique narrative possibilities of Live Cinema also come from the live situation itself, which turns the live process of creating the audiovisual material into narrative flow. This inherent flow can be hidden by the performer or made even more explicit, up to the point of directing the overall rhythm of the piece. Personally, I think that accentuating the processual nature of live cinema is key to reach the maturity of this art form. This is the reason on my focus in live drawing as a central element of live cinema/live animation performances.

Drawing is an profoundly performative act. The hand is physically mediated by the drawing tool and surface, but at the same time, the gesture can possibly transmit more directly than anything else the raw emotions of the artist in the moment of creation. The finished drawing is only the residue

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79 Randy Jones, "New Eyes for the Mind" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 121.

of this process, and taken away from the temporal (performative) narrative from which represents the final stage, it becomes an independent object with its own dynamics (the spatial relationships between shapes and forms, the visual pattern of colors, etc.). This focus on recording the drawing in time as fundamental part of the piece can be traced back to the work of the pioneers in absolute film, such as Eggling, Richter, Ruttman and Fischinger[80].

Illustration 5: Jackson Pollock's action painting.

During centuries the visual arts (in the western world) were focused in the final object that results form the creative process. The 20th century witnessed a dramatic change in this focus, towards the processual nature of art (fluxus and happenings during the 60's[81] being quintessential examples of process-based art). The following two examples can still be inscribed in the realm of object-oriented art, but show the increasing importance of the gesture and the ephemeral:

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80 A. L. Rees, *A History of Experimental Film and Video* (London: British Film Institute publishing, 1999), 37.
81 Günter Berghaus, *Avant-garde performance: Live Events and Electronic Technologies* (Hampshire, UK: Palgrave Macmillan, 2005), 79-131.

1. Jackson Pollock's action paintings[82] are probably more about the movements and gestures that the artist made over the canvas than about the resulting, static painting. These paintings seem to exist at a crux between the object and the gesture.

2. In Le mystère Picasso[83], a documentary by H. G. Clouzot released in 1956, we can see, among other things, the transformation in Picasso's painting between a vase of flowers, a fish, a cock and, finally, a human face (see Illustration 6). This transformation is probably more fascinating that the final painting itself. Maybe part of this fascination come from the fact that he is Picasso, but we can see nonetheless live painting (or drawing) as a potentially new art form that combines performance (and even ritual) with older traditions and techniques of visual arts.

It is worth noting that recent X-ray studies of paintings from famous classic Renaissance and Modern masters show that painters often made extreme changes in the canvas during the process. Moving forward to contemporary painting, there is a whole practice of performance painting where the actual piece consists in the artist performing the painting (Miriam Cabessa[84] is an artist who exemplifies this form of live or performance painting).
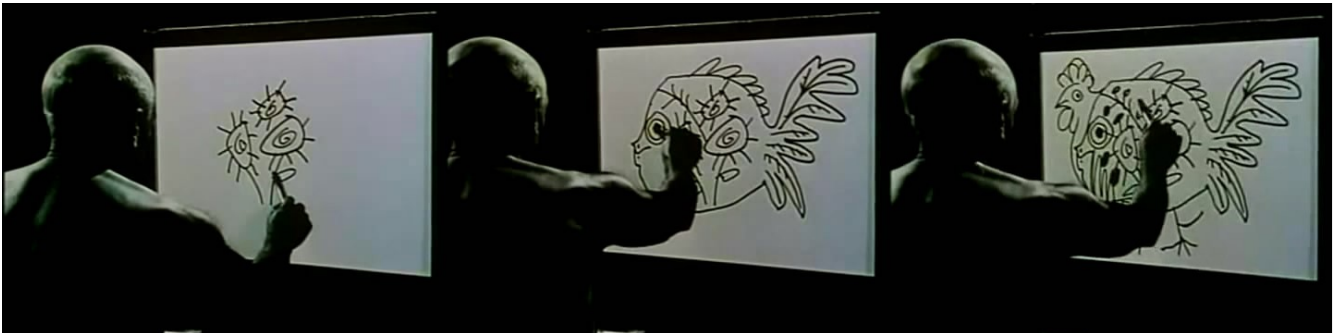
Illustration 6: Sequence from the movie "Le mystère Picasso".

Live drawing certainly is also closely connected with traditional animation. However, the fact that the line is created in "real-time" in front of the audience creates a number of unique narrative and visual challenges and opportunities. For instance, the act of drawing the line becomes the animation itself, or at least part of it. Many experimental animators have focused in the drawing/painting process

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82 Catherine M. Soussloff, "Jackson Pollock's Post-Ritual Performance: Memories Arrested in Space", *The Drama Review 48*, num. 1 (2004), 60-78.

83 Picasso is painting, http://www.youtube.com/watch?v=Bo9UDldSDgk (accessed August 29, 2009).

84 Miriam Cabessa hompeage, http://www.miriamcabessa.com/ (accessed August 29, 2009).

as the source of the animated image, for example the Welsh painter Clive Walley in his piece *Divertimento no. 3 – Brushwork*[85]:

> *"[...] the axis of depth in a painting which archives its history [...] And more than that, I was interested in imaging the process of painting rather than the results, because in much analysis of modern painting process is the key idea. The problem is that people who are not painters have not feeling for what 'process' might contribute to the meaning of a painting, so Brushwork was an attempt to use the extra dimension of time in a moving image to emphasize it."*

Here it is interesting to note that the use of live drawing in live cinema can evolve (at least) into two directions: one is the formal exploration of the dynamics, meanderings and changes of the creative process reflected by the time-recording of the line, while another would be (more difficult perhaps) to incorporate the process itself into the ongoing narrative (abstract or otherwise). This latter approach would take care of Walley's concern of a non-trained audience being unable to fully appreciate the processual nature of live drawing.

Digital media greatly facilitates the practice of live drawing. Real-time capture and digitalization of video and hand gestures allow to build innovative systems for real-time animation, as Scott Snibbe[86], Golan Levin[87], Zach Lieberman[88] and others have shown. The collaboration between experimental animator Pierre Hebert and sound artist/composer Bob Ostertag is also an notable example of the possibilities of live drawing/animation[89,90,91] where the use of digital tools moves well beyond the initial technophoric state[92] into rich narratives taking full advantage of the specificity of the medium.

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85 Maureen Furniss, *Art in Motion. Animation Aesthetics* (New Barnet, UK: John Libbey and Company Ltd., 2007), 37.
86 Scott Snibbe, "The Motion Phone", *Proceedings of Ars Electronica* (1996).
87 Scott Snibbe and Golan Levin, "Interactive Dynamic Abstraction", *Proceedings of the Symposium on Nonphotorealistic Animation and Rendering, Annecy, France* (2000).
88 Zachary Lieberman's drawn (installation), http://www.thesystemis.com/drawnInstallation/ (accessed August 29, 2009).
89 Living Cinema: Bob Ostertag and Pierre Hébert, http://www.youtube.com/watch?v=UoKEYBVld6I (accessed August 29, 2009).
90 Between Science and Garbage (Pierre Hébert/Bob Ostertag) 1, http://www.youtube.com/watch?v=xVk0QqY9A6s (accessed August 29, 2009).
91 Between Science and Garbage (Pierre Hébert/Bob Ostertag) 2, http://www.youtube.com/watch?v=JdviUBSlH-I (accessed August 29, 2009).
92 Randy Jones, "New Eyes for the Mind" in *The Cinematic Experience*, ed. Boris Debackere and Arie Altena (Amsterdam: Sonic Act Press, 2008), 126.

Illustration 7: Stills from Living Cinema performance by Pierre Hébert and Bob Ostertag.

The technique of rotoscoping[93], widely used in traditional animation since the early twenty century have a great potential to integrate live animation and drawing with digital video (live or pre-recorded) in the context of live cinema. While in principle rotoscoping allows for the creation of animations with a high degree of realism, exploiting certain characteristics of the technique such as boiling (caused by the slight deviations from the true line that differ from frame to frame, thus causing the animated line to shake unnaturally) can lead to very unique stylistic choices that accentuate surreal or dream-like qualities. The music video Take on Me and the feature film Waking life are clear examples of the potential of this technique to evoke strangeness and out-of-the ordinary experiences and feelings. Furthermore, recent advances in computer graphics[94] would allow to do realtime video rotoscoping during live performances.
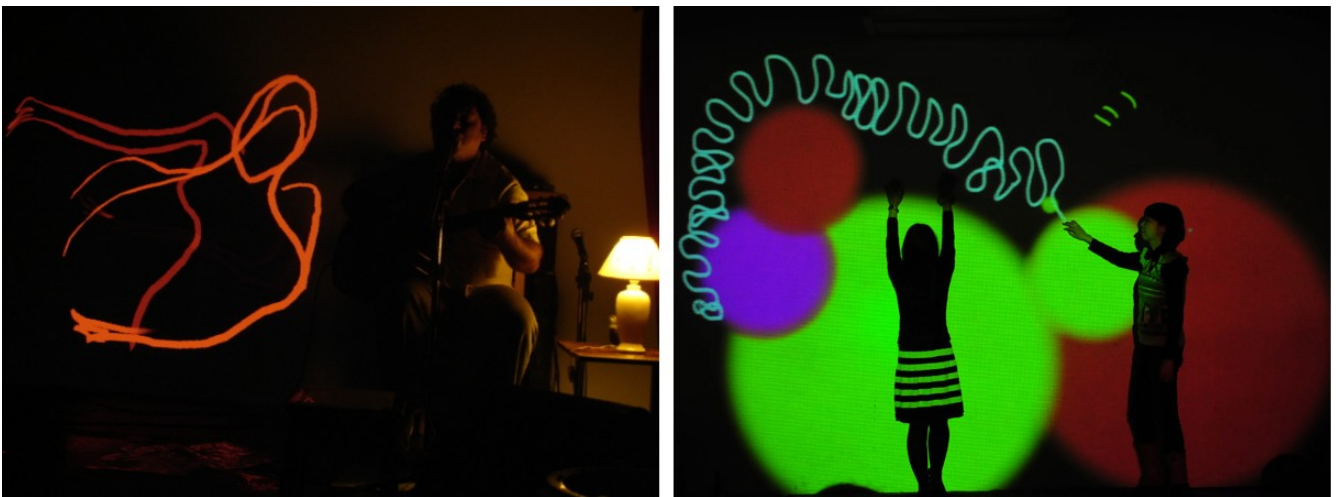
Illustration 8: Live drawing by Marcela Rapallo (left) and Shantell Martin (right).

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93 Furniss, *Art in Motion*, 76-77.
94 Aseem Agarwala, Aaron Hertzmann, et al., "Keyframe-Based Tracking for Rotoscoping and Animation", *ACM SIGGRAPH '04 conference proceedings* (2004).
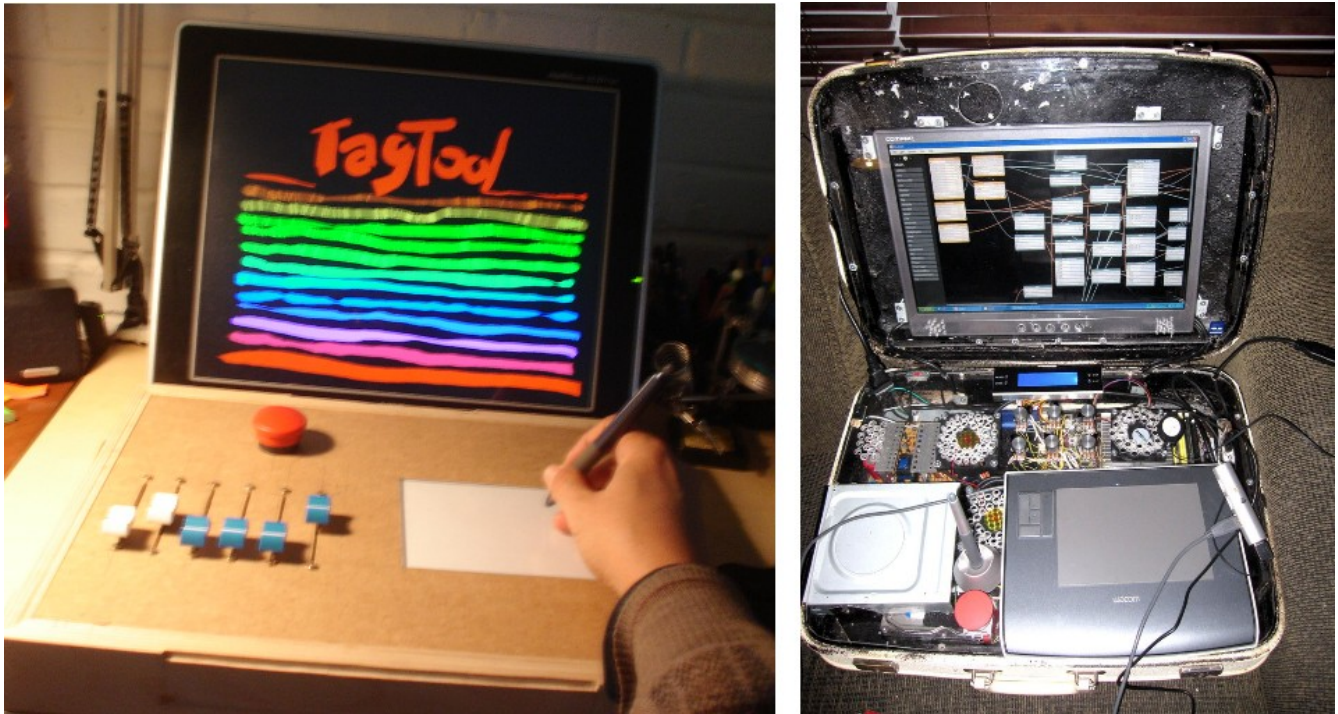
Illustration 9: Tagtool cases.

With the widespread accessibility of laptop computers, graphic tablets and low-cost cameras, the practice of digital live drawing can be found in different parts of the world. Look for example at Argentinean visual artist Marcella Rapallo[95] (who uses the open source framework for live interpretation Moldeo[96], locally developed in Argentina), NYC-based British illustrator Shantell Martin[97], and the multiple performance groups whose work is based on tagtool[98]. Live Cinema is a growing and diverse art practice where multiple approaches, an active community of artists/programers and media convergence (as well as divergence) is generating exiting and highly personal work. Randy Jones conclusion in his essay "New Eyes for the Mind" is very significant in this regard:

> *"In today's digital media landscape, full of tools and distribution systems that tend to replace the individual viewpoint with a commercial rather than a communal one, celebrating personal vision is a radically democratic goal."*

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95 Dibujar Instantáneas blog, http://www.dibujarinstantaneas.blogspot.com/ (accessed August 29, 2009).
96 Moldeo homepage, http://www.moldeo.org/principal/home/e-home.php (accessed September 1, 2009).
97 Shantell Martin homepage, http://shantellmartin.com/ (accessed August 29, 2009).
98 Home of the tagtool, http://www.tagtool.org/wp/ (accessed August 29, 2009).

1.7 Case studies

In this section I present three case studies that could be inscribed within the form of live audiovisual performance: Sue-C and Laetitia Sonami's "Sheepwoman", "Living Cinema" by Pierre Hebert and Bob Ostertag, and Laurie Anderson's "The End of the Moon". The first two could further classified as Live Cinema pieces making full use of the medium of the laptop computer and the digital projector. Both pieces show the richness in expressive possibilities that emerge from the collision between analog and digital media. Laurie Anderson's work is more of a referent for 70's and 80s multimedia performance, but it is relevant nonetheless as a classic reference as well as a paradigmatic example of the stage role of the AV-performer.

1.7.1 Sue-C and Laetitia Sonami's Sheepwoman

Sheepwoman[99] is a live audiovisual performance piece by Sue-C[100] and Laetitia Sonami[101]. Sue-C is a visual artist whose work mixes video and laptop performance with traditional media like watercolor and drawing; and Laetitia Sonami is an experimental musician and composer, who created her own unique performance tool to sculpt soundscapes in real-time: the Lady's Glove. Hence, in Sheepwoman Sue-C performed the majority of the visual elements of the piece, while Laetitia Sonami was in charge of the sounds and music (although there was some overlap between the two artists). I had the opportunity to see two consecutive performances of Sheepwoman at the Resonant Forms festival at the LACE gallery in Los Angeles.

Sheepwoman opens up for discussion many relevant questions in the context of live laptop performance. First of all, I'll start by noting that Sheepwoman was introduced as a "live film". The nature of live film, or live cinema as this form of live audiovisual performance is more commonly referred as, was discussed in the previous sections. A broad definition of live cinema proposed by Mia Makela is "the simultaneous creation of sound and image in real time by sonic and visual artists who collaborate on equal terms and with elaborate concepts". I tend to shy away from definitions and their attempt to tabulate and digest artworks with accepted labels. On top of that, Sheepwoman took place at

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99 Sheepwoman – a live film, http://sheepwoman.com/ (accessed August 29, 2009).
100 Sue-C homepage, http://www.sue-c.net/ (accessed August 29, 2009).
101 Laetitia Sonami homepage, http://www.sonami.net/ (accessed August 29, 2009).

a venue where experimental and avant-garde (wherever that word means today) works have been exhibited since the late 70's. Isn't one of the goals of experimental art to defy conventions and definitions? Nonetheless, I began this discussion precisely with the issue of defining the piece because I think that the choice of the term "live film", instead of the more generic "audiovisual performance", was very conscious and relevant to discuss the nature of the piece.

If we ask ourselves what are the physical spaces required to the (non-live) construction of a film, the following list might suffice in most of the situations: a set or stage where the action is shot with a camera and sounds are recorded, the editing room where the different scenes are combined together into a linear montage, and the projection screen (plus the surrounding space for the audience) where the film is ultimately shown.

Illustration 10: Sheepwoman Live Film performance by Sue-C and Lateitia Sonami at the Resonant Forms festival (LACE gallery, Los Angeles).

Sheepwoman in fact retains all these traditional elements: there is a miniature set where small CCTV cameras move around and the actual, physical action takes place and its shot. The editing room is now the computer, where the digitalized filmed material is stored, combined and processed into a linear sequence of audio and video frames (adding perhaps some non-live materials). Finally, the images are projected onto the screen and sounds played back through the speakers in the room where the audience has gathered to see the piece.

The nature and scale of these elements (sets, sound stage, editing room, projection screen) have changed, but their roles remain the same. There is one key difference, though, which justifies the term "live film": all these elements exist in the same space and are used simultaneously, as opposed to conventional film where they occur sequentially one after the other (shooting on the sets during the production phase, followed by post-production editing and finally, projection at the movie theater). These considerations lead to the following definition of live film:

Live film is a form of cinema where the sets and sound stage, editing room and projection screen share the same space and time.

This proposed definition does not just restates the obvious, but it tries to re-interpret traditional film making concepts by confronting with ideas of simultaneity and spacial co-existence. The digital doesn't have a central role in terms of the building blocks of what live film is or could be, but it constitutes nonetheless the enabling technology that allows for this simultaneity of shooting, editing and projection: the **digital real-time**.

This idea of temporal and spacial co-existence of the sets and the projection screen connects with a concept that was discussed earlier, that of closed versus open liminality. Both the sets and the screen inhabit the same place but are not cannot be identified with each other in the sense that the projection doesn't occur on the set like in many digital dance performances, where even the body of the dancers become the screen. The screen and the sets are clearly delimited, and hence the liminal space is explicitly determined by the physical space between them. More importantly, this gap is not hidden from the audience, on the contrary it becomes a very important part of the piece, and the gaze moving back and forth between the screen and the "real" object being filmed creates dialogical and narrative layers which I think are unique to this art form.

There is another element which I found extremely important in Sheepwoman and would like to explore in my own pieces, and it is the role of the laptop performer. While during most of the performance both Sue and Laetitia were sitting in front of their tools and controls, Sue used a flashlight to illuminate parts of the set to create very dramatic moments at certain points during the piece (see Illustration 11). Given the size and distribution of the elements on the set, this action was much more physically involved, requiring her to sit on the table and move around the set structures. Sue become

then much more visible to the audience, abandoning the usual, protected role of a laptop performer.

Illustration 11: Sue-C manipulating a
flashlight during a scene of Sheepwoman.

I felt that, in a strange way, she turned into an actor in the movie, connected to the ongoing narrative not only by the effects her actions with the flashlights created on the screen, but as some character looking for some lost object in the space conveyed by the sets. I think that this type of physical involvements and actions create new performative and narrative possibilities that extend the limits of live cinema and live film into more theatrical expressions.

1.7.2 Living Cinema by Pierre Hebert and Bob Ostertag

The Living Cinema[102]. project is the result of the collaboration between sound artist Bob Ostertag[103] and Canadian experimental animator Pierre Hebert[104] This work is remarkable by its (highly conscious) mixing of digital and analog elements: although the final projected image is the result of digital image processing, most of the source material for this real-time processing comes the manipulation of physical media: ink, pencils, old toys, newspapers, soda cans, etc. Live animation is a central element in this work, but is not mediated through a device for capturing the hand gestures. A video camera is located over the desk where the performers manipulate the various artifacts and materials, the live video feed of the brush and pencil strokes is directly fed into the computer, looped and combined with other layers of image and video.

I would like to point out three aspects of this work that are important in relation to my project:

1. the immediateness of real-time animation, and the constraints imposed on it by the live nature of the piece. These constraints push the animation into a more plastic form, and also more revealing of the dynamic qualities of the drawn gesture.

2. there is no attempt to conceal the "improvised" and "found" nature of the objects, which accentuates their materiality. This in fact plays with the themes of the piece (war, consumerism, etc.)

3. all the visual content is also generated in real-time (in contrast with most of live cinema pieces where, even when there is use of live camera feeds, pre-recorded video clips constitute the main source of visual material). The loops that result of recording the live camera feed are played back many times during the piece, layered together and processed.

These elements contribute to create a very unique live cinema piece that moves away from a more polished style that is often seen in live laptop performances. Of course this is so not because technical limitations of the artists, but rather it reflects very conscious decision to play with the digital medium and the physical materials in order to reach a more critical piece at the subject and formal levels.

102Living Cinema, http://bobostertag.com/music-liveprojects-livingcinema.htm (accessed August 29, 2009).

103 Bob Ostertag homepage, http://bobostertag.com/ (accessed August 29, 2009).

104 Pierre Hébert homepage, http://www.pierrehebert.com/ (accessed August 29, 2009).

1.7.3 Laurie Anderson's The End of the Moon

Laurie Anderson[105] is one of the most recognized American artists coming from the so-called "media generation" of the seventies, and her performance pieces during the next decade, such as "United States"[106], were characterized by the use of a multiplicity of different visual and acoustic resources. Her work, while not so closely related to the live cinema form discussed so far, sets an important antecedent for my own work in regards to theatricality and bodily presence.

She performs on-stage with a number of electronic and digital devices: most notably the tape-bow violin and talking stick of her own invention, but also with live cameras, audio processing equipment, etc. But she doesn't remain behind the controls, on the contrary, she is an active performer with a central presence on the stage, a narrator of stories and anecdotes who skilfully plays not only with the instruments just mentioned but also with the intonation of her voice, her motions on the stage, etc.:

"the stage events had a high degree of physical presence – the presence of the human body, of the technical apparatus, of the interaction between them"

She plays out with notions of theatricality that move away from traditional acting and simulating of reality. Her work pioneered the concept a new type of media performer who operates her digital devices on stage, being this operation an integral part of the narrative.

Laurie Anderson was the first artist in-residence at NASA back in 2002. Incidentally, the second space shuttle accident, when Columbia disintegrated upon re-entering Earth atmosphere, occurred during her residency. As result of this residency, she created the piece "The End of the Moon" [107]. This piece has relevance for my own project not only because the thematic connection, but also because it is an example of how an artist comes up to terms and describe concepts and visions that are at the evoke marvel and escape human scales. She plays out with a juxtaposition of the trivial and the extraordinary, and this echoes with some of the goals of this project:

"This juxtaposition of futuristic high-tech modernity and very personal feelings, of cool factualness and surreal landscapes, of paranoia and comedy led the audiences into a precarious, disjointed postmodern space that reflected the contradictions inherent in contemporary Western society."[108]

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105 Laurie Anderson homepage, http://www.laurieanderson.com/ (accessed August 29, 2009).

106 Günter Berghaus, *Avant-garde performance: Live Events and Electronic Technologies* (Hampshire, UK: Palgrave Macmillan, 2005), 220.

107 Interview to Laurie Anderson, http://www.pomegranatearts.com/project-laurie_anderson/pdf_files/la_interview_04.pdf (accessed August 30, 2009).

108 Günter Berghaus, *Avant-garde performance: Live Events and Electronic Technologies* (Hampshire, UK: Palgrave

Illustration 12: Stills from Laurie Anderson's performance "The End of the Moon".

Macmillan, 2005), 223.

Part 2: Practice. Latent State Live Cinema piece

2.1 Background

The Live Cinema piece created within the framework of this MFA thesis is entitled Latent State and, speaking in broad terms, it is inspired in equal parts by childhood memories of the tragedy of the space shuttle Challenger[109] and by later rationalizations of space travel fantasies. As a source of both wonder (Carl Sagan's Cosmos) and terror (Ridley Scott's Alien) in popular culture, space exploration in general and the figure of the astronaut in particular are heavily loaded icons with multiple meanings. The space-inspired imaginery reached many aspects of everyday design during the height of the so-called space age in the 60's: furniture, clothes, toys, architecture, etc. [110], and these far reaching effects that can still be seen today.

Subject-wise, this piece locates itself within a larger body of artistic interests which goes from the purely personal - as a member of the generation which witnessed the Challenger accident on TV as a 9-10 years-old children (generation who a friend of mine suggested could be even called the "Challenger generation" as much as we could talk of a "JFK generation") - to the political and speculative: 2009 marks the 40th anniversary of man reaching the moon (an event as loaded of child-like wonder as much as geo-political implications). The space shuttle, the most technologically advanced manned spaceship to date, will be decommissioned next year without a clear replacement in sight. With the NASA and the Russian space programs facing increasingly severe budget constraints and, at the same time, new national "contenders" (Europe, India, China) as well as private companies coming into the scene, the future of space exploration seems open and unpredictable. In more metaphorical terms, humanity is leaving the "latency stage" of the early space age and moving into the dangers of "adulthood".

As a child growing in Argentina during eighties, I was a distant spectator of the events in the so-called space race between United States and the Soviet Union. Popular mass media at that time (TV, movies, magazines) was the channel through which I had access to these images and associated

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109 Rogers Commission report, "Report of the PRESIDENTIAL COMMISSION on the Space Shuttle Challenger Accident", http://history.nasa.gov/rogersrep/genindex.htm (accessed August 30, 2009).
110 Sean Topham, *Where's my space age? The rise and fall of futuristic design* (Munich: Prestel Verlag, 2003), 57-113.

discourse. The early eighties still carried some of the idealized perception of space exploration as the next step in the technical, social and cultural evolution of humanity. This perception can be traced back to the work of writers, thinkers, and scientists from late 19th century (Jules Verne[111], Konstantin Tsiolkovsky[112], Robert Goddard[113]), and fully realized in the sixties with the first manned missions, the Apollo landings on the moon and later in the 70's with the constant human presence in orbit by means of Soviet, American and, in the present, multinational space stations (MIR, Skylab, ISS).

Popular science books for children as well as science fiction films and TV series such as Carl Sagan's Cosmos all contributed to create a mixture of imagination and reality about space travel, which was the fertile ground for playfulness and fantasy. The Challenger accident 1986 was very significant in relation to this adventurous, idealized perception of space. Its impact as a tragedy mediated through television, broadcasted in real time to millions of people around the globe and replayed continuously in the subsequent days, could be compared to as the assassination of John F. Kennedy in 1963 in terms of its instantaneous global reach.

There are several studies[114,115,116] dealing with the psychological consequences among the children who watched the Challenger explosion, either live at Cape Canaveral or through TV. These studies focus on a specific age range, between 8 and 12 years, period called latency state in Freudian psychology. Common thinking and memory patterns were found among these children: a more pessimistic view of space travel and the country in general, the realization of existence of death. Is it possible to speak of a "Challenger generation" as a result of this event?

The last decade of the 20th century witnessed a waning of previous futuristic depictions of humanity conquering outer space, and a simultaneous rise of the information technologies, the Internet, and a focus in the "inner space" or "ether-net" of networked communication. The image of the man of the future, the astronaut venturing into space, was replaced by the cyber-naut and the hacker accessing the Internet from diminutive portable devices.

Space has been a source of amazement and wonder since the earliest times of humanity. At the

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111 Jules Verne, *From the Earth to the Moon* (1865).
112 Konstantin E. Tsiolkovsky, *The Exploration of Cosmic Space by Means of Reaction Devices* (1903).
113 Robert Goddard, *A Method of Reaching Extreme Altitudes* (1919).
114 Lenore C. Terr et al., "Children's memories in the wake of Challenger", *American Journal of Psychiatry 153* (1996) 618-25.
115 Lenore C. Terr et al., "Children's thinking in the wake of Challenger", *American Journal of Psychiatry 154* (1997) 744-51.
116 Lenore C. Terr et al., "Children's Symptoms in the Wake of Challenger: A Field Study of Distant-Traumatic Effects and an Outline of Related Conditions", *American Journal of Psychiatry 156* (1999) 1536-44.

same time, the deep relation between space exploration, scientific interests, international politics, national pride and economics creates deep contradictions and open questions. Many artists had explored these gray areas between the mundane and the extraordinary: Jane and Louise Wilson, Børre Sæthre, Fergal Stapleton, Bryan Cyril Griffiths[117], David Wilson[118], Laurie Anderson with her piece *The End of the Moon*. As Sean Topham concludes in his book "Where's my space travel?"[119]:

> *"Now the space age has found its way into the art gallery and is coming under the scrutiny of a new generation of artists, who are embracing their own voyage of discovery. Just as the reactions to Yuri Gagarin's first orbital flight and Neil Armstrong's first steps on the moon ranged from horror to amazement, the work of these artists evokes feelings that are similar in scope. It would be wonderful to be able to see the space age through innocent eyes, but the dark history behind the grand experiment will always be there to cloud the sensation of child-like wonder."*
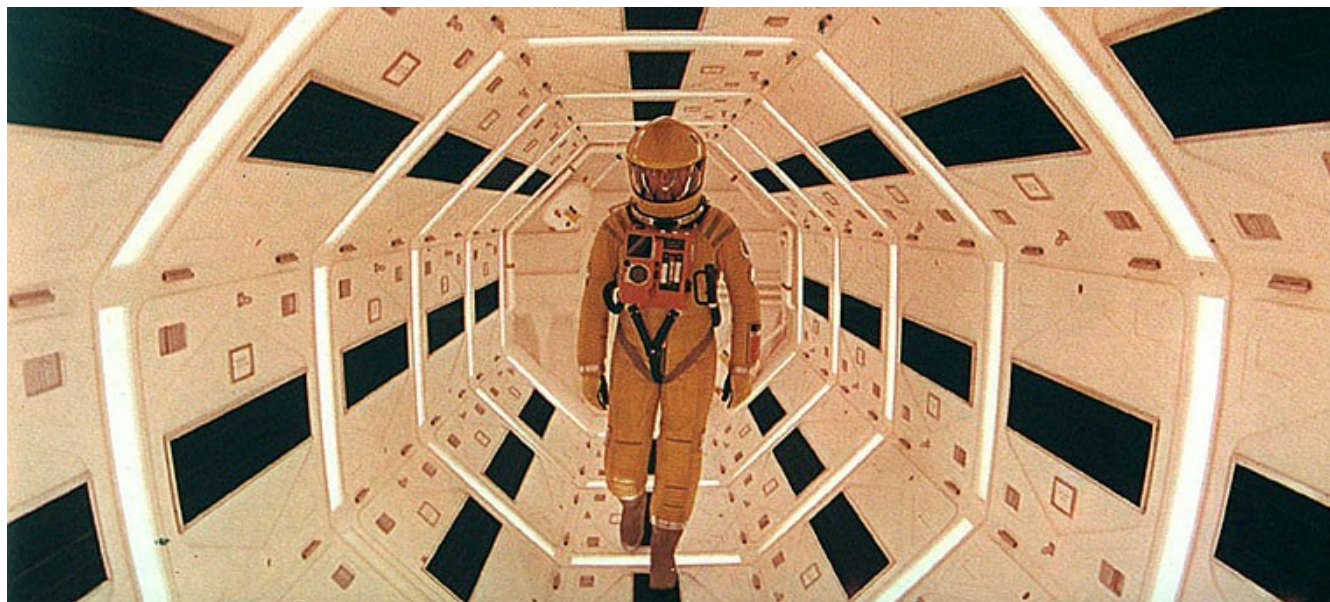
Illustration 13: "2001: A Space Odyssey" from Stanley Kubrick is a hallmark science fiction movie from the 60s with iconic images of space exploration.

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117 Topham, *Where's my space age?*, 115-55.

118 Jeanne Scheper, "Feasting on Technologies of Recycling in the Jurassic: Repositories of Knowledge and the Desire for Minutiae and Exegesis, with the true account of a conversation with the Museum of Jurassic Technology's progenitor and prognosticator, David Wilson", *Other Voices* 3, num. 1 (2007), http://othervoices.org/3.1/dwilson/index.php (accessed August 30, 2009).

119 Topham, *Where's my space age?*, 156-7.

2.2 The Challenger accident of January 26th, 1986

The now iconic trail of smoke and debris against the blue sky right after the Challenger space shuttle disintegrated during launch was the result of an also iconic error: the "O-ring" failure. The live demonstration by Nobel-prize physicist Richard Feynman of the weakness of the O-ring material under the icy conditions at the launch pad is quite famous and available for viewing at youtube[120]. This failure revealed deep problems in the way NASA used components built by sub-contractors to assemble the space shuttle, and how bureaucracy stomped the early warnings from engineers[121]. The US manned space program got into a halt for 3 years until new prevention measurements and technical improvements in the space shuttle were put into place.

The space shuttle represents a technical achievement that hasn't been matched yet: a (partially) reusable spaceship which is capable of landing back on the earth like an airplane. By doing so, it materializes many of the fantasies of space travel transmitted from the early days of adventure space fiction stories of the 40s and 50s[122].

Illustration 14: Space Shuttle Challenger disintegrates during lift-off.

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120 Richard Feynman talks about the O ring, http://www.youtube.com/watch?v=8qAi_9quzUY (accessed August 29, 2009).
121 Malcolm McConnell, *Challenger : A Major Malfunction : A True Story of Politics, Greed, and the Wrong Stuff* (Doubleday, 1986).
122 Adam Roberts, *The History of Science Fiction* (New York: Palgrave Macmillan, 2006), 196-203.

However, the shuttle represents a financial failure due to the much-higher than anticipated costs per launch. The accident of the Challenger in January 26th 1986, and more recently the loss of the shuttle Columbia during atmospheric re-entry, have undoubtedly contributed to the decision to end the space shuttle program and retire the remaining vehicles (Endeavor, Discovery and Atlantis) as early as 2010. This occurs in a context of global economic downturn and uncertainty where expensive space exploration projects face substantial budget cuts or outright cancellation.

The Challenger accident took place in a moment where launches of manned missions were already accepted as everyday events by the population at large, and hence had lost most their appeal as TV broadcasts. This particular launch, however, had the added novelty of being the first mission with an astronaut from the Teacher in Space Program[123]: Christa McAuliffe. She was a high school teacher selected from a pool of volunteers to be trained as an astronaut and deliver classes from space to the children back on Earth. The presence of Christa McAuliffe was the reason for a larger than usual number of children watching the launch of Challenger, both at Cape Canaveral and by TV. The implications of this fact will be discussed in more detail in the next section.

The events that lead to the destruction of the Challenger were exhaustively documented by a multiplicity of on-board sensors, cameras and other devices. Consider, for instance, the transcript of the Challenger crew comments as registered by the operational flight recorder:

```
CDR..........Scobee

PLT..........Smith

MS 1.........Onizuka

MS 2.........Resnik

(The references to "NASA" indicate explanatory references NASA provided to the
Presidential Commission.)

Time Crew Crew

(Min:Sec).........Position Comment

T-2:05............MS 2..... Would you give that back to me?

T-2:03............MS 2..... Security blanket.
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123 The Challenger Story: The Teacher in Space Project, http://www.challenger.org/about/history/index.cfm (accessed August 30, 2009).

T-2:02............MS 2..... Hmm.

T-1:58............CDR..... Two minutes downstairs; you gotta watch running down there?

(NASA: Two minutes till launch.)

T-1:47...........PLT..... OK there goes the lox arm.

(NASA: Liquid oxygen supply arm to ET.)

T-1:46...........CDR..... Goes the beanie cap.

(NASA: Liquid oxygen vent cap.)

T-1:44...........MS 1..... Doesn't it go the other way?

T-1:42........... Laughter.

T-1:39...........MS 1..... Now I see it; I see it.

T-1:39...........PLT..... God I hope not Ellison.

T-1:38...........MS 1..... I couldn't see it moving; it was behind the center screen.

(NASA: Obstructed view of liquid oxygen supply arm.)

T-1:33. ....MS 2..... Got your harnesses locked?

(NASA: Seat restraints.)

T-1:29...........PLT..... What for?

T-1:28...........CDR..... I won't lock mine; I might have to reach something.

T-1:24...........PLT..... Ooh kaaaay.

T-1:04...........MS 1..... Dick's thinking of somebody there.

T-1:03...........CDR..... Unhuh.

T-59.............CDR..... One minute downstairs.

(NASA: One minute till launch.)

T-52.............MS 2..... Cabin Pressure is probably going to give us an alarm.

(NASA: Caution and warning alarm. Routine occurrence during prelaunch).

T-50.............CDR..... OK.

T-47.............CDR..... OK there.

T-43.............PLT..... Alarm looks good.

(NASA: Cabin pressure is acceptable.)

T-42..............CDR..... OK.

T-40..............PLT..... Ullage pressures are up.

(NASA: External tank ullage pressure.)

T-34..............PLT..... Right engine helium tank is just a little bit low.

(NASA: SSME supply helium pressure.)

T-32..............CDR..... It was yesterday, too.

T-31..............PLT..... OK.

T-30..............CDR..... Thirty seconds down there.

(NASA: 30 seconds till launch.)

T-25............PLT..... Remember the red button when you make a roll call.

(NASA: Precautionary reminder for communications configuration.)

T-23............CDR..... I won't do that; thanks a lot.

T-15..............CDR..... Fifteen.

(NASA: 15 seconds till launch.)

T-6..............CDR..... There they go guys.

(NASA: SSME Ignition.)

MS 2..... All right.

CDR..... Three at a hundred.

(NASA: SSME thrust level at 100% for all 3 engines.)

T+O..............MS 2..... Aaall riiight.

T+1..............PLT..... Here we go.

(NASA: Vehicle motion.)

T+7..............CDR.............Houston, Challenger roll program.

(NASA: Initiation of vehicle roll program.)

T+11..............PLT..... Go you Mother.

T+14..............MS 1..... LVLH.

(NASA: Reminder for cockpit switch configuration change. Local vertical/local horizontal).

T+15.............MS 2..... (Expletive) hot.

T+16.............CDR..... Ooohh-kaaay.

T+19.............PLT..... Looks like we've got a lotta wind here today.

T+20.............CDR..... Yeah.

T+22.............CDR..... It's a little hard to see out my window here.

T+28.............PLT..... There's ten thousand feet and Mach point five.

(NASA: Altitude and velocity report.)

T+30........... Garble.

T+35.............CDR..... Point nine.

(NASA: Velocity report, 0.9 Mach).

T+40.............PLT..... There's Mach one.

(NASA: Velocity report, 1.0 Mach).

T+41.............CDR..... Going through nineteen thousand.

(NASA: Altitude report, 19,000 ft.)

T+43.............CDR..... OK we're throttling down.

(NASA: Normal SSME thrust reduction during maximum dynamic pressure region.)

T+57.............CDR..... Throttling up.

(NASA: Throttle up to 104% after maximum dynamic pressure.)

T+58.............PLT..... Throttle up.

T+59.............CDR..... Roger.

T+60.............PLT..... Feel that mother go.

T+60........... Woooohoooo.

T+1:02...........PLT..... Thirty-five thousand going through one point five

(NASA: Altitude and velocity report, 35,000 ft., 1.5 Mach).

T+1:05...........CDR..... Reading four eighty six on mine.

(NASA: Routine airspeed indicator check.)

T+1:07...........PLT..... Yep, that's what I've got, too.

T+1:10...........CDR..... Roger, go at throttle up.

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(NASA: SSME at 104 percent.)

T+1:13............PLT..... Uhoh.

T+1:13.....................LOSS OF ALL DATA.
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Shortly after the accident, NASA released a technical documentary showing with excruciating detail all the stages in the short flight of the Challenger up to the moment of the explosion, followed by a millisecond analysis of the shuttle disintegration and subsequent debris fall, as well as computer animations explaining the reasons of the structural failures leading to the disaster. These videos are available for viewing on youtube[124,125,126,127].

Similar materials - even more detailed - from the Columbia accident[128] have this terrifying quality of showing with extreme accuracy and scientific detail the last moments in the life of a group of human beings. Media coverage after the Challenger disaster further speculated[129] with the possibility of the crew being alive and conscious at the moment of the crew compartment hitting the sea, two minutes after the orbiter break-up during lift-off.

Illustration 15: Illustration 15: Sequence showing the disintegration of the Challenger as the structural failure becomes larger.

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124 NASA-The Challenger Disaster-Part 1, http://www.youtube.com/watch?v=25wl7rxAegE (accessed August 30, 2009).
125 NASA-The Challenger Disaster-Part 2, http://www.youtube.com/watch?v=4MaqhFFtxk8 (accessed August 30, 2009).
126 NASA-The Challenger Disaster-Part 3, http://www.youtube.com/watch?v=Qt4pU3dFhCA (accessed August 30, 2009).
127 NASA-The Challenger Disaster-Part 4, http://www.youtube.com/watch?v=E0yEc-iVSH0 (accessed August 30, 2009).
128 NASA, *Columbia Crew Survival Investigation Report*, http://www.nasa.gov/pdf/298870main_SP-2008-565.pdf (accessed August 30, 2009).
129 Dennis E. Powell, "First came the bang. Then...silence. A story about catastrophe and coverup" *Miami Herald*, 13 November, 1988, Tropic Sunday magazine, Florida edition.

2.3 Psychological effects of the Challenger disaster on Latency Stage children

Detailed studies by a group of psychiatrists from the University of California, San Francisco and the School of Medicine at Stanford were carried out after the Challenger accident in order to measure its effect on memories[130] and thinking[131] among normal latency-age children and adolescents who witnessed the accident (either directly at the launch site or on TV), as well to identify post-traumatic stress disorder symptoms[132]. These studies were conducted at different times after the Challenger disaster (5 weeks later and 14 months later) to quantify the change in the effects and symptoms.

Numerous statistics where compiled with the structured-interview responses from randomly selected children. These statistics focus on aspects such as fantasies about the Challenger and the accident (causing/preventing the explosion), realization and fear of death, supernatural and paranormal experiences, attitudes about the world's future, etc. Table 1, extracted from one of the articles, shows some of this statistics.

Latency stage[133] is the term assigned in psychology to the period of children psycho-sexual development between 5-6 years of age until the start of puberty. According to the Freudian theory, this is a period of relative calm in terms of purely sexual development, so the energy the child previously put into the Oedipal problem can be used for developing the self and acquiring new knowledge and skills. The child has evolved from a baby with primitive drives to a reasonable human being with complex feelings like shame, guilt and disgust.

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130 Lenore C. Terr et al., "Children's memories in the wake of Challenger", *American Journal of Psychiatry 153* (1996) 618-25.
131 Lenore C. Terr et al., "Children's thinking in the wake of Challenger", *American Journal of Psychiatry 154* (1997) 744-51.
132 Lenore C. Terr et al., "Children's Symptoms in the Wake of Challenger: A Field Study of Distant-Traumatic Effects and an Outline of Related Conditions", *American Journal of Psychiatry 156* (1999) 1536-44.
133 A. Etchegoyen, "Latency – a reappraisal", *International Journal of Psychoanalysis 74* (1993) 347-357.

Significance of Change Over Time[b]	Very Involved East Coast Children (N=68)	Less Involved West Coast Children (N=60)	Latency-Age Children (N=68)	Adolescents (N=60)
Diminishing types of thinking				
$p<0.0001$	Seeking knowledge with teachers, with parents Fantasies about *Challenger* Supernatural experiences: paranormal	Seeking knowledge by oneself, with parents Talking about *Challenger* Fantasies about *Challenger*	Seeking knowledge by oneself, with parents Talking about *Challenger*	Seeking knowledge with teachers, with parents Fantasies about *Challenger*
$p<0.001$			Avoidance of thinking too much	Supernatural experiences: paranormal
$p<0.01$	Talking about *Challenger*	Avoidance of thinking too much	Seeking knowledge with teachers Fantasies about *Challenger*	
$p<0.05$	Avoidance of thinking too much	Seeking knowledge with teachers	Supernatural experiences: ability to predict	Talking about *Challenger* Supernatural experiences: ghosts/presences
Steady or increasing types of thinking				
$p>0.10$	Avoidance of talk about the subject Experiencing omens Changed attitudes about space *Challenger*-based life philosophy	Avoidance of talk about the subject Experiencing omens Changed attitudes about space Negative predictions about the world's future *Challenger*-based life philosophy	Avoidance of talk about the subject Experiencing omens Changed attitudes about space, about the United States Negative predictions about the world's future	Avoidance of talk about the subject Experiencing omens Changed attitudes about space *Challenger*-based life philosophy
$p=0.05–0.09$		Changed attitudes about the United States	*Challenger*-based life philosophy[c]	
$p<0.05$	Changed attitudes about the United States[d]			Negative predictions about the world's future[d]
$p<0.01$				Changed attitudes about the United States[d]

[a]Change from 5–7 weeks to 14 months after the disaster.
[b]The p values are derived from paired-comparison t tests.
[c]Although this finding reflects a diminution over time ($p<0.06$), all other findings regarding *Challenger*-based life philosophies remained steady.
[d]This finding reflects significantly increasing national and world views.

Table 1: Changes in Children's Thinking Over Time After the Challenger Disaster (from 5-7 weeks to 14 months after the disaster)

Among the newly discovered knowledge during the latency phase is the realization of death. Answers by the children interviewed in these studies are a clear example of this, and very striking by revealing the sudden awareness of non-existence provoked by witnessing the Challenger accident:

"I've been worrying a lot—what it feels like not to exist."

"I'm a little aware now of what it feels like to die. I thought about it, maybe five times. I used to not think about it at all."

"Having a bad feeling as you die scares me."

"I had a dream the other night of a fire in my barn. One horse of mine and eight other horses were killed."

49

Another important pattern found among the children was a negative change in attitudes and perceptions in relation to the United States, space exploration and the future in general. Even more importantly perhaps is the fact that these negative attitudes increased substantially (nearly doubling) in the adolescent group one year after the accident. Similar pattern was found among the latency stage group, with less of a statistically significant increase but still with remarkably steady negative perceptions over the 1-year study period[134]. Further quotes from the children exemplify these attitudes:

"I feel angry—more than ever before—at NASA."
"We Americans are the first ones to have something like hat blow up. It makes me feel bad, sort of, for our country."
"I was so mad, I wanted to punch somebody—anybody. I was mad at God. God might have wanted the shuttle to explode. Or the devil."

"I don't trust our country as much. They can make other mistakes, worse mistakes."

Is it possible to even talk of a Challenger generation? According to the facts mentioned in the previous paragraph and further remarked by the conclusions from these studies, this seems plausible:

> *"Over the year, omens, paranormal experiences, and Challenger-based fantasies tended to disappear, but negative views about institutions and the world's future held steady or increased [...] Distant disasters appear to set up commonalities of thought that might come to characterize certain generations of children."*

2.4 Latent State storyboard

The piece is based on four semi-independent blocks or chapters that were gradually developed and scripted over a period of three months. Different arrangements of these chapters were tried out in order to find a meaningful overall narrative arch. Each one of these chapters focus on a specific theme or event, and through their linear arrangement I tried to communicate the oppositions that are central to the piece: play/death, fantasy/reality, wonder/terror. The four chapters are the following:

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134 Terr et al., "Children's thinking", 749.

1. Innocence: this is achieved by impersonating childhood fantasies of space travel. First, by using paper rockets and other simple objects and playing out with them a mission to the moon. Second, by re-enacting parts of the Challenger crew dialog with walkies-talkies and hence emphasizing the idea of child-play. The audio also tries to be playful and consists of the 60's popular hit Telstar by the Tornados mixed together with some more suggestive and strange electronic sounds extracted from the soundtrack of the 70's Osaka World Expo.

2. Tragedy: explicitly conveyed by playing back the original TV Challenger launch news report, with the live comments that describe the shuttle's lift-off and eventual explosion in mid-air. The purpose of this chapter is to narrowly focus the attention of the audience in the drama of this sequence of events. The audio is just voice the anchorman, first relating the launch in a casual manner as things seem to be progressing normally and then turning into surprise and shock when the shuttle disintegrates.

3. Contemplation: Two sources of audiovisual material are combined to create a moment of calm and reflection after the violence of the disaster. One source is the NASA post-flight analysis documentary with its original audio (a cold and detached voice-over explaining the technical and engineering aspects of the flight and catastrophe), while the second source is a live camera feed of the children's quotes mentioned in the previous section, directly captured by sweeping a web-cam over paper copies of the psychiatry articles containing the text.

4. Rebirth: where I literally become an astronaut by drawing a helmet on top of my face, captured with a live camera, and then burning the image into white. This sequence is inspired, in part, by the scene in 2001, A Space Odyssey where Dave goes through the time-space vortex and we can see a frontal close-up of his face. The burning-to-white transition is accompanied by the sound of jet engines becoming progressively louder, to then abruptly stop at the end.

The final linear arrangement follows a logical progression innocence – tragedy – contemplation – rebirth, which proved to be effective to convey the overall mood of the piece to the audience in the four occasions it was performed: two at the Experimental Digital Arts (EDA) space at UCLA, as part of the final MFA show, and the other two at the Museum of Jurassic Technology (MJT) in Culver City, a couple of weeks later. These experiences will be recounted in the subsequent sections.

Each one of the four chapters relied on a different performance technique, with the first chapter being the most involved in terms of storyboard and technical complexity. This chapter combined live

video capture of the action performed on a small stage, consisting in a space mission sequence as it could be enacted by a children playing with his toys: rocket blasting-off from the launch pad, space capsule traveling through space and final moon landing. The live camera feed is combined with live drawing performed with a graphics tablet: the objects and contraptions I manipulate on the stage are "augmented" digitally with the addition of live drawn animations of fire, smoke, stars, planets, comets and, at the end of the sequence, with the astronaut coming out from the capsule and venturing into the lunar landscape. In order to give the live camera feed a certain cartoonish style and also to visually merge the video of the physical objects with the digital line, real-time custom-made posterize and edge detection filters were applied to the layers containing the video and drawing. The last scene of the moon landing was further processed adding a scanline filter to create the feeling of watching a 60's space transmission (see Illustration 16). Illustration 17 shows pages of the storyboard for this chapter.

Illustration 16: Moon landing TV footage.

The second and third chapters (Tragedy and Contemplation) were much simpler in terms of implementation, since they either require only playback of an unmodified video clip, or a mix of two raw video sources, one a video and the other a live camera feed.

Finally, the fourth and concluding scene requires again real-time processing of video image together with layered composition of live camera feed with digitally drawn elements, as the astronaut helmet is added on top of the camera capture. A bloom filter is gradually applied to the composition to create the burn-to-white effect, which ends abruptly together with the sound when all the screen is pure white, thus signaling the end of the piece. The designs for the helmet are show in the Illustration 18.
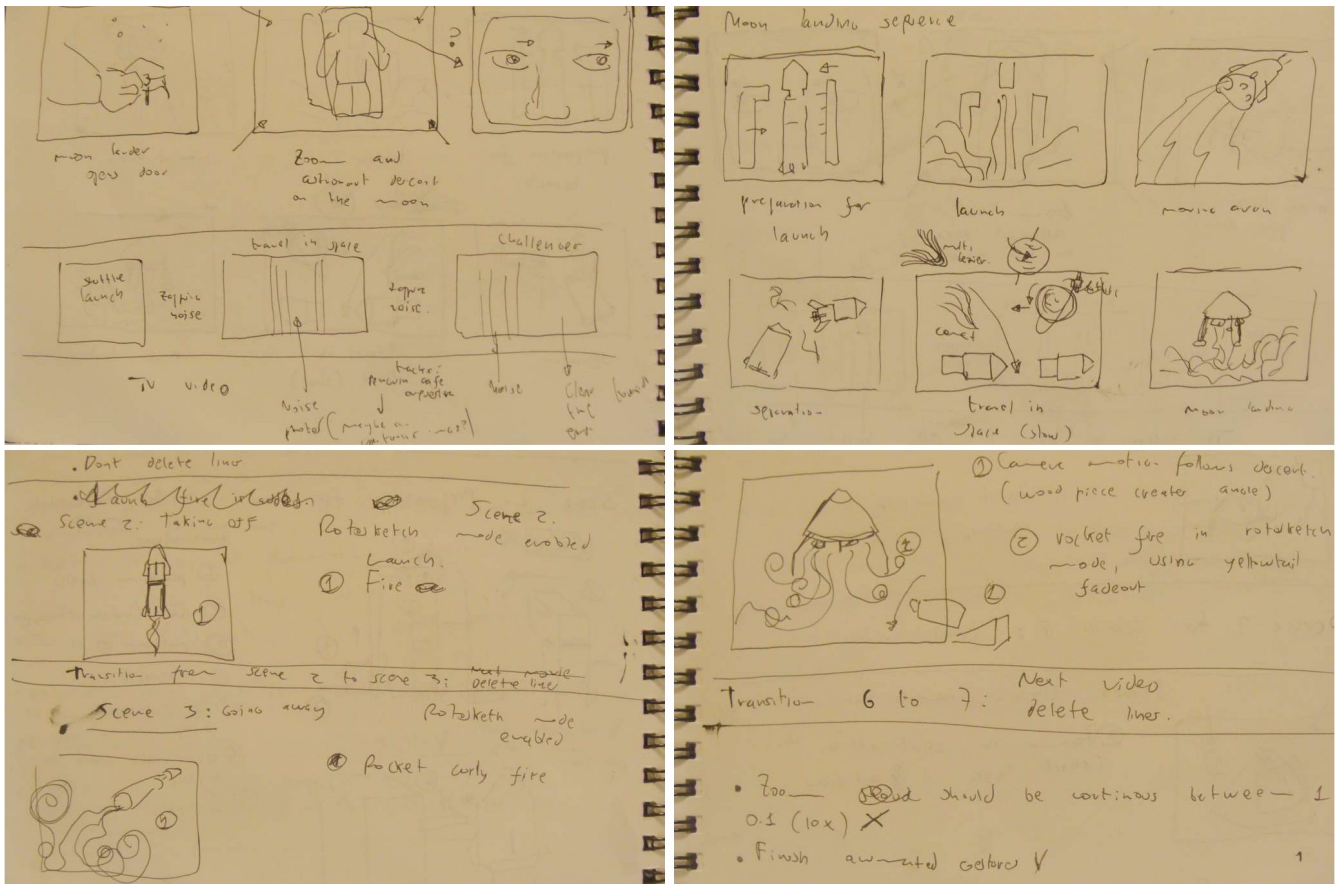
Illustration 17: Pages from the storyboard for the first chapter of Latent State, showing the space travel sequence.
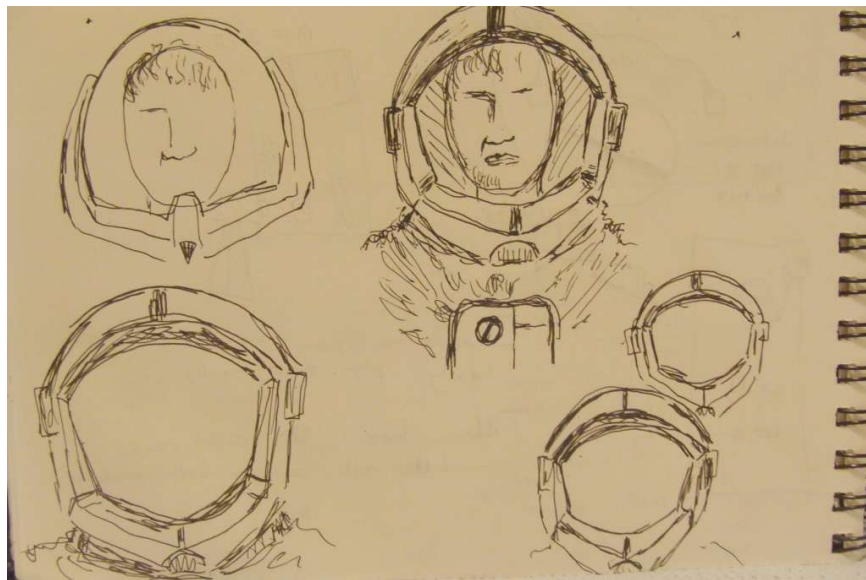

Illustration 18: Sketches of helmet designs for the final chapter of the piece.

2.5 Performance at the Experimental Digital Arts space

The Experimental Digital Arts (EDA) space at the Broad Arts Building served as the location for the two first performances of Latent State, which took place on May 12th 2009. This space normally functions as an exhibition gallery, and this influenced some of the decisions I made in terms of selection and arrangement of elements (screens, stage props, lighting, audience seats) used during the performance. In order to make use of the empty "white cube" space of the gallery I built a multiple-screen setup with a general stage area divided in zones, one for each chapter of the piece: a rotating mini-stage to perform the child-play with toy rockets, as well as the live drawing with the graphics tablet, a couple of white stands supporting the small TV used to play back the Challenger explosion sequence, as well as a small machine that unrolled a long strip of paper containing the transcript of the Challenger crew comments mentioned earlier, and then a desk where the Contemplation section takes place when I browse through the pages of the psychiatry articles. The narrative flow physically moves through these different areas, starting at the mini-stage (Innocence), then shifting to the TV (Tragedy), later to the desk (Contemplation) and finally returning to the mini-stage area for the final Rebirth sequence.

This setup is reminiscent of video inter-media installations of the 70's and 80's (Vito Acconci[135], Laurie Anderson[136]), which differentiates my piece from more conventional live AV laptop-performance works which usually consist, in terms of the spacial arrangement, in a desk where the electronic equipment is laid out and a screen area. The performer in such situations usually remains behind the laptop without having significant exterior performative role. Here, the physical layout of elements required active displacements between the different zones, which was part of the performance not only circumstantially, but also as a way to emphasize the very personal nature of the piece which ends with myself (the laptop performer) explicitly becoming an astronaut during the Rebirth sequence.

This first version of the piece also had the participation of a second performer, Johanna Reeds, who enacted the NASA voice during the walkie-talkie recitation of the Challenger crew comments, by the end of the first part.

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135 Art Space Talk: Vito Acconci, http://www.myartspace.com/blog/2008/04/art-space-talk-vito-acconci.html (accessed August 30, 2009).
136 Silicon Valley Radio, Transcript of the Laurie Anderson Interview, http://www.transmitmedia.com/svr/vault/anderson/ander_transcript.html (accessed August 30, 2009).

From a more technical point of view, the live-drawing sequence relied on capturing video from the live camera over-viewing the mini-stage area, recording it into small clips and then looping these clips in order to add the digitally drawn elements. This proved to be somewhat unsuccessful, since the continuous looping created a sense of excessive repetition among the audience.

Probably by virtue of being the first time the piece was performed, all the sequences were highly scripted with very few chances for variation or improvisation. However, a software glitch during the second performance, which prevented a whole set of live-drawing steps to be carried out in the pre-determined order, didn't have a very serious effect since I was able to adjust the performance to take into account this unexpected event.

Later discussions with some of the attendants to these two first performances were highly rewarding since they showed that the piece created multiple emotional responses in the audience. Also, certain aspects of the piece particularly attracted criticism, such as whether or not to show the actual disintegration of the Challenger.
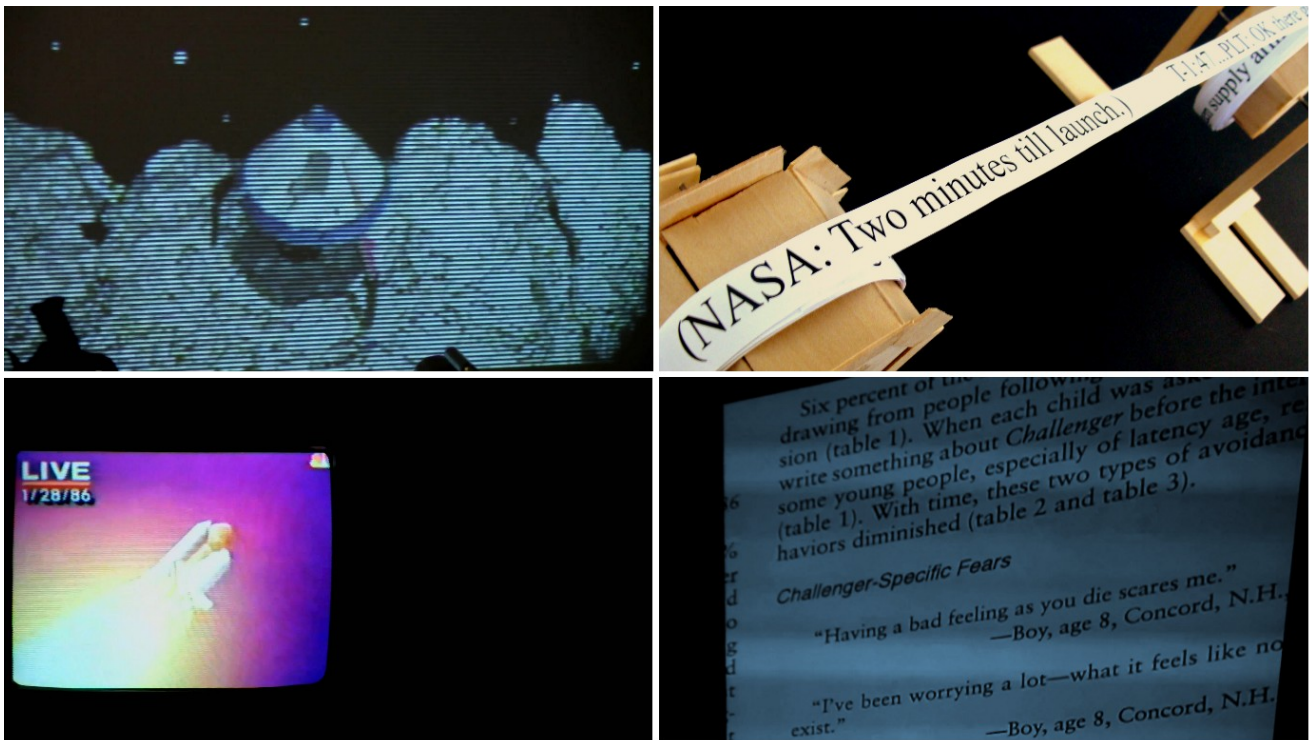
Illustration 19: Some stills from the EDA performance: moon landing (upper left), crew dialog machine (upper right), Challenger TV news (lower left), Children quotes (lower right).

2.6 Performance at the Museum of Jurassic Technology

Two additional performances of Latent State were carried out at the Museum of Jurassic Technology (MJT)[137], a few weeks after the EDA performances. This Museum is a unique space created by David Wilson in the early 90's, and has been steadily gaining world recognition since then (mostly by a word-of-mouth effect). It is accurate to describe the MJT as a entire art piece, which draws its initial inspiration from the "Cabinet of Curiosities" of the 17th and 18th centuries. The permanent "collections" exhibited in the museum combine strangeness, fantasy and reality to create a sense of amazement among the visitors. The second floor in particular is devoted to the theme of space travel, of course with a rather unique perspective centered in the image of the space dogs of the soviet space program (by means of a collection of paintings starting with the famous Laika). After contacting David Wilson and his assistant, Alexis Hayman, we realized the Museum was in fact a very appropriate location for my piece, given the theme and nature of Latent State.

Illustration 20: Nana Tchitchou in the Tula Tea Room at the MJT. Photo by Ryan Schude.

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137 Museum of Jurassic Technology homepage, http://www.mjt.org/ (accessed August 30, 2009).

The performance was staged in the Borzoi Cabinet Theater, a small movie theater located in the second floor of the Museum and suitable for accommodating 15-20 people. As mentioned above, many of the exhibits in the second floor (the space dog paintings, sketches from pioneer writer Konstantin Tsiolkovsky) were a particularly good match to the theme of the piece. However, the space was quite different from the original gallery setting in the EDA performances. I had no room for the multiple props I used back then, and this time I was restricted to a single projector/screen. This constrains in fact made me to focus in the central elements of the piece, and also to rethink the piece in terms of a single attention point for the audience.

The physical arrangement also turned to be quite interesting from a conceptual point of view: the stage area (with the new mini moving panorama I built specially for this performance) was located right below the cinema screen. So the "shooting" of the movie occurred (almost) in the same space as the projection of the resulting image. This constitutes a good example of the idea of open liminality, discussed in the first part of this essay.

Another important change in the piece was the replacement of the rotating mini-stage of the first performances at the EDA by a new contraption, this time a small panorama device[138] that allowed me to scroll a long piece of paper in front of the camera. This scroll was punctured by small holes, and by placing a set of light bulbs in the interior of the panorama box I was able to create a moving star field, effect that proved to be quite successful in combination with the other props (paper rocket, moon landscapes, etc) and further digital processing. This device presents many potential uses that weren't fully explored, such as drawing or painting directly on the surface of the moving paper.

The issue commented brought forward when discussing the EDA performance - excessive repetition - was solved by drawing not on pre-recorded loops, but directly on the incoming live video feed. This of course requires a more involved execution of live drawing, since I had to handle the objects being filmed with one hand while drawing on the live video with the other. Improvements in the software substantially increased the performance of the tool, and this proved to be quite important to maintain a fluid video playback and layering of effects and drawing elements.

Due to the limited time to rehearse in this new space, these two performances of Latent State resulted to be less structured, with more unexpected glitches and more improvisation. This, together with the atmosphere conveyed by the Museum, contributed to create a more satisfactory artistic result.

138Stephan Oettermann, *The Panorama. History of a Mass Medium* (New York: Zone Books, 2007), 49-97.
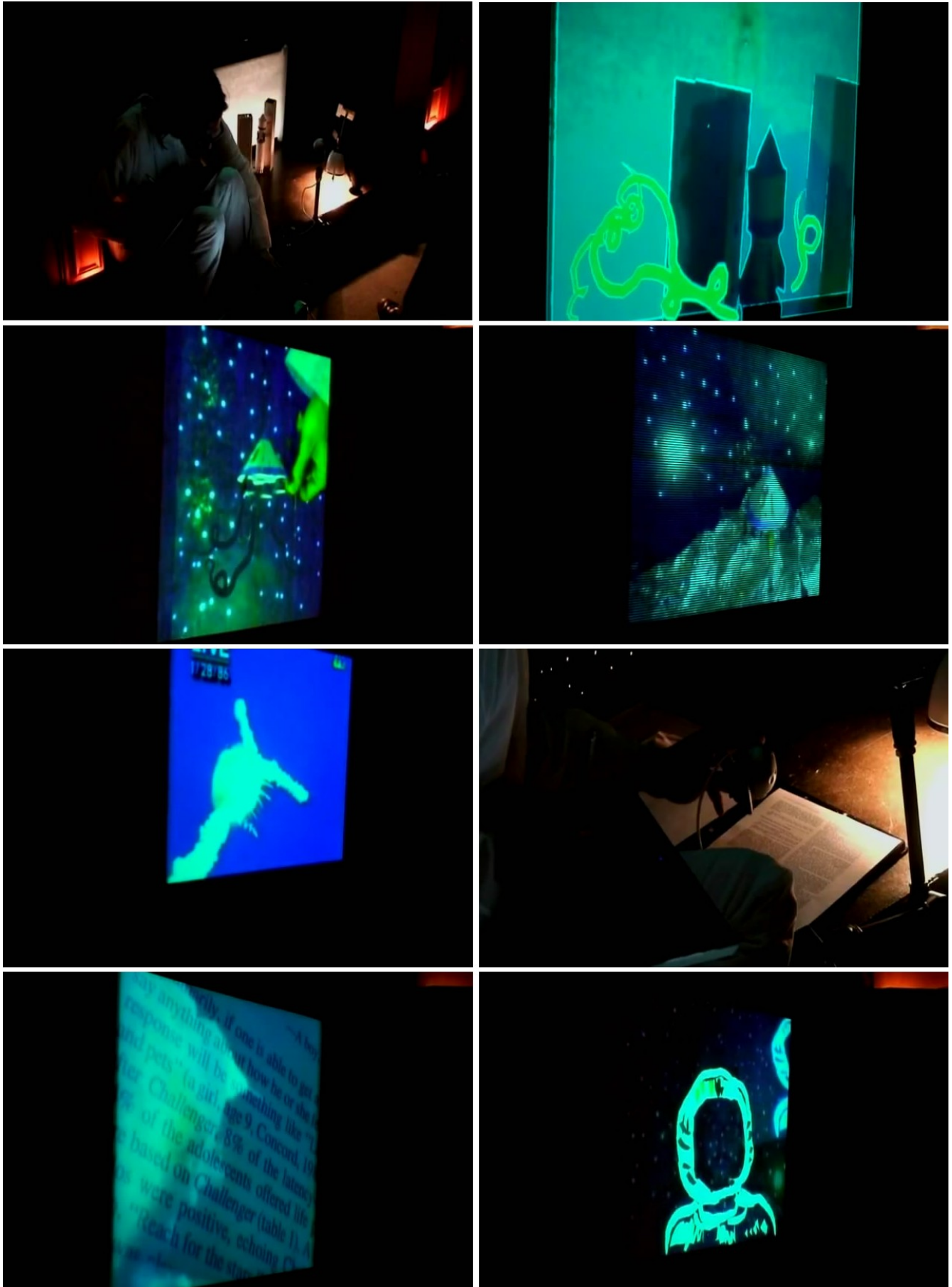
Illustration 21: Stills from the Latent State performance at the Museum of Jurassic Technology.

Conclusions

The project described in this essay hopefully represents the starting point of a line of work rather than a concluded piece. As an artist looking for means to convey very personal emotions to a diverse audience, I have just scratched the universe of narrative forms, audiovisual rhythms and patterns, cinematic conventions and post-cinematic possibilities. To make effective use of these elements as the building blocks of my own personal language, a long process of conscious and unconscious learning, experimentation, success and failure is needed. In this conclusion I would like to answer this question: did the work carried in the context of this thesis project shed any light on the nature of this unique language and did provide any insights on the possible methodologies required for its construction?

The form of performance poses a number of challenges to the aspiring practitioners. More even so when surrounding themselves with additional layers of mechanism and abstraction (the computer and its various input devices, the digital processing algorithms, etc). Was I able to successfully integrate these extra layers into my expressive body at the moment of the performance? Probably the answer to this question is not a resounding yes, at least for now, but there is definitely the potential to create much more refined Live Cinema pieces in the future. As one possible indicator of this potential, I'd like to point out the following circumstances: during the performances at the MJT, I encountered a few glitches that prevented me to carry out specific parts of the piece in the scripted order. However, I was able to work around these glitches and continue with the overall flow of the piece. This required some improvisation with the performance instruments (software, graphics tablet, etc). I think that adaptability and improvisation in situations like this account for a certain level of deeper integration between the performer and his instruments, which is essential for the success of live audiovisual performance.

A more important question for me to answer is the following: was I able to channel at least part of the emotional themes (childhood fantasies of space travel, discovery of death, etc.) which for me defined this first piece? Reactions from the audience seemed to indicate that such thing indeed happened up to a certain extent, with various degrees of agreement as for the effectiveness of the particular choices of elements, media, rhythms, etc. But as long as this question deals more with issues of acceptance of the work, it is perhaps far more important to evaluate my success in creating a highly

personal piece and being able to deliver to an audience without concerns about acceptance or rejection.

The work was out there, as an ephemeral expression of ideas and feelings, left for the audience to decode and interpret (or ignore) in the ways they saw fit. And I think that I succeeded in this regard, specially when considering my background in more technical skills (programming) and interests in the aesthetics of formal systems (mathematics, algorithms). Elements of the performance had an almost ritual nature connecting with formative experiences from childhood, and for me this piece represents some sort of a passage experience, from the technical (structures for control) to the poetic (metaphor moments). Before I mentioned the search for a new language, and I believe that this project provided me with a glimpse to a language of ephemeral moments (real-time, live creations) where the effects of a techno-digital oriented society clash with the need of a return to the poetics of embodied experiences (performance). As such, this seems to be a language of constant opposition and conflicts, and it remains to be seen if the resolution of these conflicts are the definitive abandon of the digital in favor of the physical (or the other way around), or some sort of negotiated co-existence.

Appendix: Andiamo. Software tool for Live Cinema performance

This purpose of this appendix is to describe the characteristics of the software tool I developed exclusively to use in the Latent State piece, called Andiamo. The next sections will introduce this tool and then discuss the different modes of operation to perform live video mixing and animation with the graphics tablet and to apply real-time filter effects to the mix.

I. Aims of the software

Andiamo is the name of the live visual laptop performance instrument[139] I'm currently developing as the central software element of this thesis project. The name is an Spanish acronym for ANimador DIgital Analógico MOdular (Digital-Analog Modular Animator), but it also means, in Italian, "let's go". I think that this meaning is particularly apt for a live performance instrument or tool, since during the occurrence of a live performance things just "go" and "flow" in the present moment. When the performance starts, there is no other option but to go ahead and completely engage with the instrument, the senses and the environment where the performance takes place.

Andiamo was created as a tool for performing live animation with different techniques such as rotoscoping, live drawing and cel animation, using a graphics tablet as the main input device. The animations can be combined with and synchronized by video captured from a live camera or read from files stored on the computer disk. Andiamo allows for live mixing, looping and montage of multiple layers of video and animation material. Furthermore, the resulting compositions can be processed in real-time with FX image filters (motion blur, bloom, edge detection, cel shading, etc.). This filters are accelerated by the graphics processing unit (GPU) in order to achieve fluid playback rates.

The graphics tablet as the main input device is a feature of another tool for live performance

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139Tad Turner, "The Resonance of the Cubicle: Laptop Performance in Post-digital Musics", *Contemporary Music Review 22*, num. 4 (2003), 81 - 92.

called tagtool[140], strongly rooted in DIY ideas and used by many artistic groups around the world. British designer and illustrator Shantel Martin[141] created a stir in the VJ scene by centering her visual performances exclusively on the technique of live drawing with a graphics tablet, without many additional real-time effects. The research of novel gestural, physical interfaces for live AV performance is very active[142], and the success of tangible interface paradigms such as ReactTable[143] shows the great interest in moving away from traditional keyboard+mouse interfaces into more embodied performance devices.

Andiamo does not try to be a general tool for live audiovisual performance (like Modul8, Arakos or MAX/Jitter), but its main goal is rather to focus in the close integration of three basic elements mentioned above: animation, video and filters. It has a certain degree of modularity and extensibility though, mainly by allowing to incorporate new drawing modes (inherited from the built-in gesture classes), and new image filters using the OpenGL Shading Language (GLSL). In order to control things outside the scope of Andiamo (sound for example), an Open Sound Control (OSC) module is available for inter-application communication.

Video and animation can be tightly combined by the use of "anchor points". These points are just two dimensional elements to which hand-drawn gestures can be attached to, so that motions in the anchors translate to motions in the drawings. In particular, Andiamo includes a GPU-accelerated point tracker (KLT-GPU), which follows "features" on a video source. The tracked features are then mapped onto the anchor points, which makes possible to have gestures responding to motions in the video (either from a live camera or a file).

Another goal of Andiamo is to provide an open platform for experimenting with different animation, drawing and video processing techniques and algorithms in the context of live performance. This is the reason why Andiamo is released as Open Source using the Artistic License, as well as being based on standardized libraries (OpenGL, OSC), Open Source when possible (Gstreamer).

Real-time video playback and effects in Andiamo are based on two Processing libraries I started to develop when I entered into the D|MA graduate program: GSVideo and GLGraphics. The work on

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140Tagtool homepage, http://www.tagtool.org/ (accessed August 30, 2009).
141Shantell Martin homepage, http://shantellmartin.com/ (accessed August 30, 2009).
142 Michael Lew, "Live Cinema: Designing an Instrument for Cinema Editing as a Live Performance", Proceedings: New Interfaces for Musical Expression 2004, Hamamatsu, Japan, June 3-5(2004), 144-149.
143 S. Jordà et al., "The reacTable", Proceedings of the International Computer Music Conference, Barcelona , Spain (2005).

these libraries was presented at the ACE conference 2008 in Yokohama, Japan[144]. They are available for download at sourceforge[145,146]. Andiamo is available at sourceforge[147] as well.

II. Architecture

The basic building block in Andiamo is the layer. A layer is an independent 2D surface that can be drawn to the screen and contains a number of dynamic graphic elements. These elements can be video, line drawing, FX filters, text, images or shapes. Layers are combined sequentially in a composition pipeline, which is rendered to generate the final visual output. The composition pipeline is entirely dynamic, meaning that layers can be added or removed during run-time. Every layer has some parameters that are common to all layer types, such as transparency and tint color, which are used to blend together all the layers in the composition.

Andiamo has a custom graphical user interface that follows three principles: minimality, dynamism and context-awareness. In the context of live performance, the responsiveness of the software tool needs to be maximized and the cluttering of the interface elements minimized, while keeping a logical workflow that eases the live operation. These are the justifications to build an interface that is minimal in its visual appearance and responds dynamically to the user: when the focus of the input moves to the live drawing area, the interface elements hide automatically in order to save space and reduce the visual clutter on the screen. Each layer type has its own unique interface (menus, buttons, etc) which are updated accordingly when the user moves between the different layers in the composition.

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144 HD (in) Processing, Proceedings of the International Conference on Advances in Computer Entertainment Technology, Yokohama, Japan (2008).
145 GSVideo homepage, http://sourceforge.net/projects/gsvideo/ (accessed August 30, 2009).
146GLGraphics homepage, http://sourceforge.net/projects/glgraphics/ (accessed August 30, 2009).
147 Andiamo homepage, http://sourceforge.net/projects/andiamo (accessed August 30, 2009).
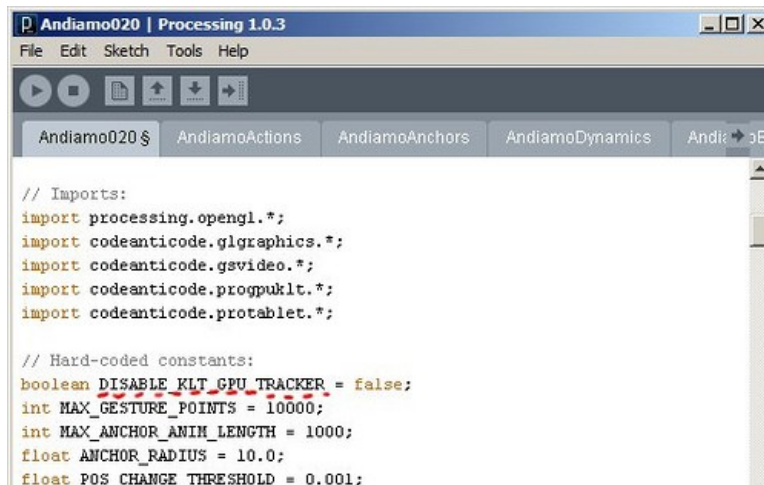
III. Installation

At this time Andiamo can be run only as a Processing sketch. It depends on a number of external libraries: GSVideo, GLGraphics, oscP5, traer.physics, proTablet and proGPUKLT. The dependency on GSVideo doesn't allow to export Andiamo as a stand-alone application yet, so the project should be open from the Processing PDE and run from there (or from Eclipse, but I haven't tried this option). The distribution of Andiamo available on sourceforge consists of two zip packages: Andiamo020.zip and libraries020.zip. The first is the complete sketch folder for Andiamo v20, while the second contains all the required libraries. The contents of the library package should be copied to the contributed libraries folder. All the required libraries could be downloaded separately from their respective sites, but newer versions might not work with Andiamo 020.

The feature tracker included in the proGPUKLT library requires a recent NVidia video card in order to work, and might prevent Andiamo from running, even if it is not used. To completely disable GPU-KLT, there is a global variable that can be set to false, DISABLE_KLT_GPU_TRACKER. This variable is defined together with other hard-coded constants in the top of the Andiamo020.pde file, right after the library import section:

IV. Interface overview

Andiamo's interface is divided in two major areas: input and output. The input area contains:

- the interface widgets for setting options, changing parameters, etc.
- the drawing surface that captures and displays the gestures generated with the graphics tablet.
- the preview window showing the current layer composition.

The sole purpose of the output area is to show the resulting layer composition in a separate screen region, in order to facilitate its display on a external monitor or projector, without any of the interface elements overlayed on the input area.

Both input and output areas can be show within the same window, or on two separate windows. The only advantage of the first approach (one window) is a slightly better performance, since rendering two independent windows has a small penalty in terms of frame rate (around 5 or 6 fps).
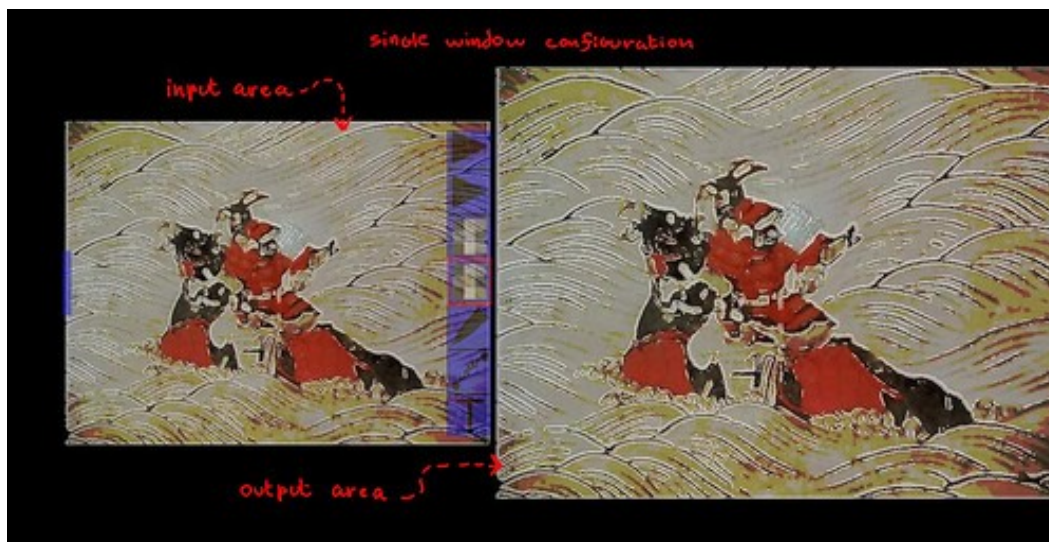
Having input and output on two separate windows also facilitates switching between different applications on the screen that contains the input window (for example, to control sound from another application).
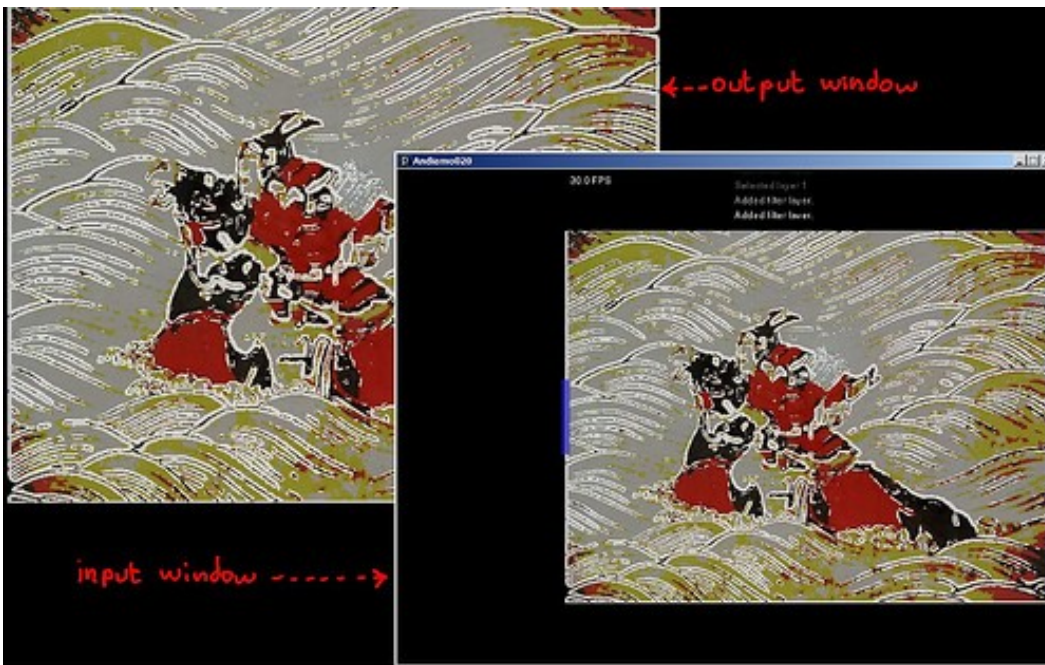
Furthermore, the output area can be disabled altogether, which could be convenient when testing or practicing. These different modes are controlled with a few global variables, located at the beginning of the Andaiamo020.pde file, after the imports section:

These global variables, highlighted in the previous figure, are: SHOW_OUTPUT_SCREEN, SINGLE_SCREEN, OUTPUT_POS_X, OUTPUT_POS_Y, inputWidth, inputHeight, outputWidth and outputHeight. SHOW_OUTPUT_SCREEN enables/disables the output region. If this variable is set to false, then the remaining ones (with the exception of inputWidth and inputHeight) don't have any effect. SINGLE_SCREEN enables/disables the display of the separate output window. When the output window is enabled, its location can be controlled with the OUTPUT_POS_X and OUTPUT_POS_Y variables. For example, if the computer is connected to a second display (e.g: a projector) and the desktop spans across both displays, OUTPUT_POS_X should be equal to the width of the first display, if the goal is to render the output window entirely inside the second display. When SINGLE_SCREEN is false, this is, input and output areas have their own separate windows, then the size of these windows are set with inputWidth, inputHeight, outputWidth and outputHeight. The meaning of these variables change in the single screen mode, in which case inputWidth and inputHeight are taken to be the size of the whole window, while outputWidth and outputHeight are used to determine area of this window that is assigned to render the output.

The output window does not have any function other than render the final visual result of the layer composition, and therefore it lacks any interactive element. The input window (or region), on the other hand, is further subdivided in three areas: preview, messages and main menu:
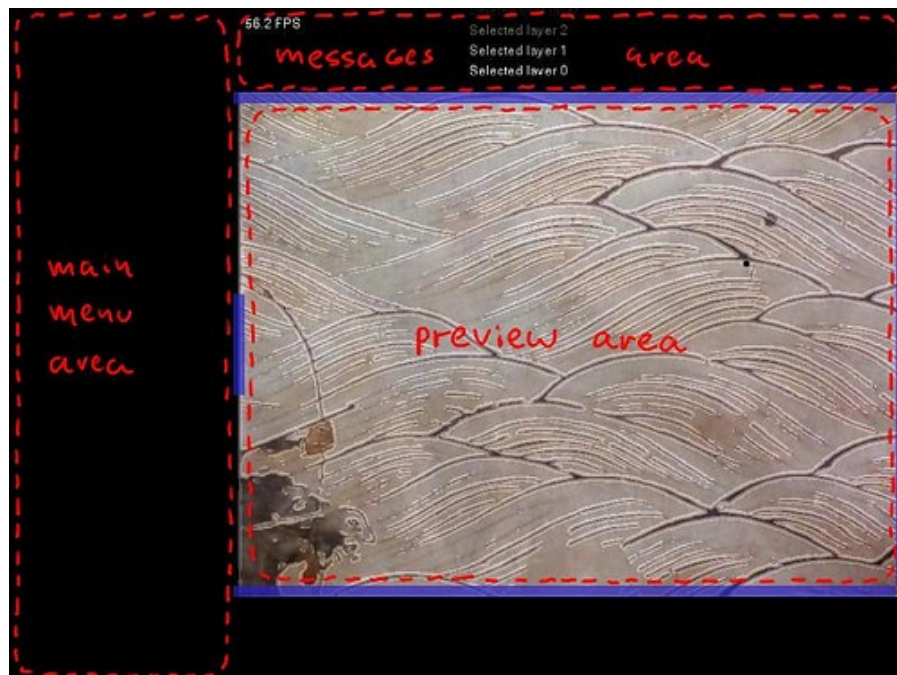
The preview area contains the main rendering/drawing/interaction surface and also the contextual menus that are used during most of the program operation. These menus are usually hidden, and only a thin semi-transparent tab is visible on the edges of the preview area for each menu as the pen is hovered (without pressing the tablet) over the preview area.
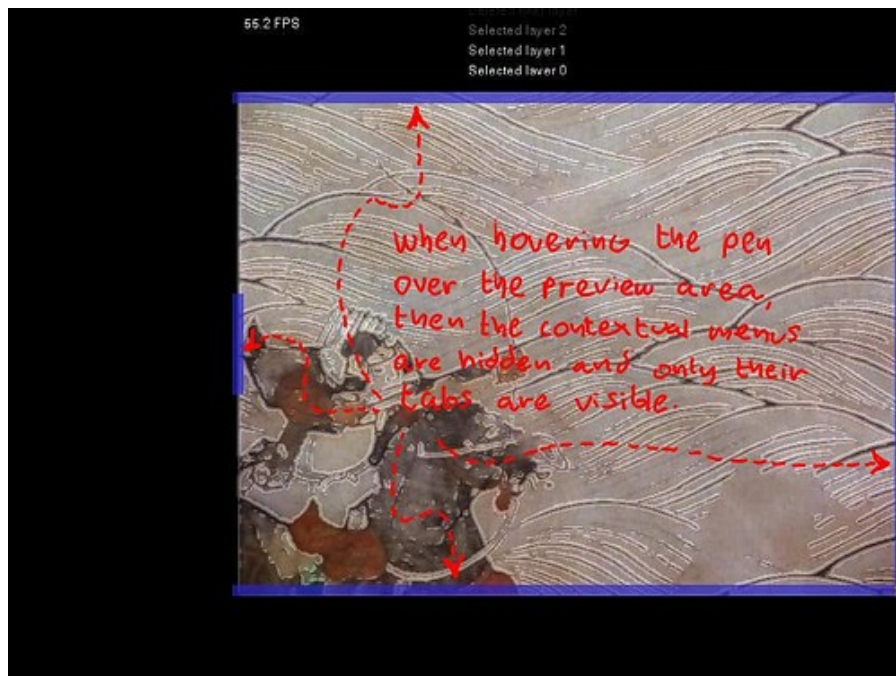
When the pen is pressed against the tabled, then the menu tabs disappear as well:

Hovering the pen over the menu tabs will make the menu to unfold:

The figure above shows the layer selection menu, that corresponds to the tab on the right edge of the preview area. This menu is not contextual in the sense that it does not depend on the selected layer. All the layers in the composition shown in the figure are shown as rectangular icons in the strip that defines the menu, and they are sorted in descending order (the top-most icon corresponds to the first layer in the composition and so on). From all these layers, there is one marked as selected, meaning that most of the input events (tablet, keyboard, mouse) will be directed to it. The selected layer appears highlighted with a red outline, and to select another layer the the pen's button (which corresponds to right button on a regular two-button mouse) has to be clicked when the cursor is over the layer to be selected. If there are more layers than space available on the strip, they can be scrolled up or down by pressing and moving the pen up and down along the strip (on a regular mouse this corresponds to click with the left button).

Another menu that is not contextual is the color selector, that corresponds to the smaller tab on the left of the preview area:

This menu allows to set the tint color (using HSB sliders) and transparency for the selected layer. Besides the color menu, each layer can have up to two contextual menus, meaning that they contain options that depend on the selected layer. These are the top and bottom layer menus. It may also happen that certain layers lack one or both of them. In the two following screen captures, the top and bottom menus shown correspond to the video layer, which will be explained in detail in the next part of this manual.
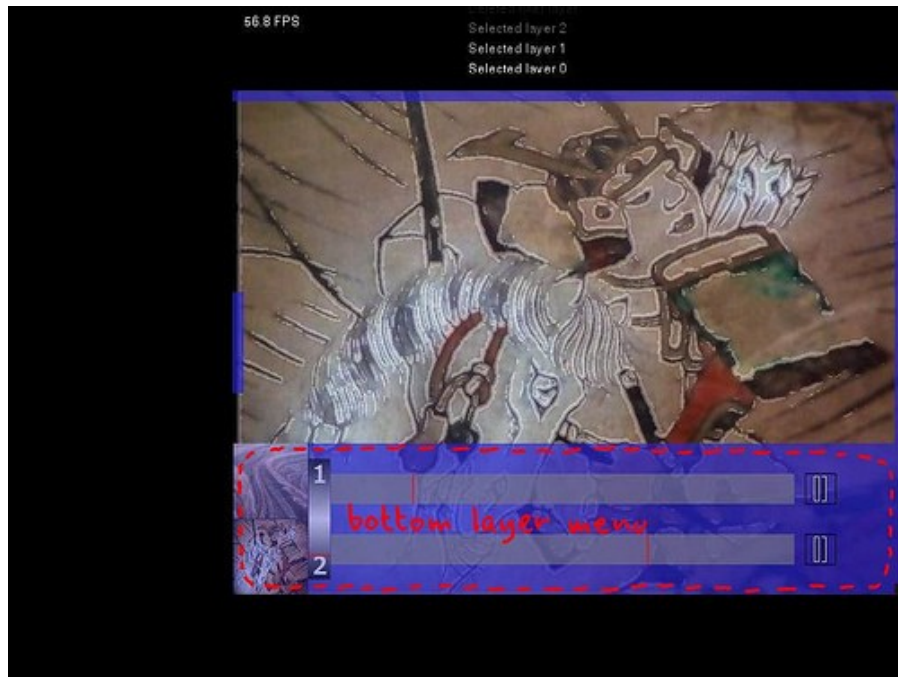
Finally, the main menu activates when hovering the pen tablet on the black area to the left of the screen:
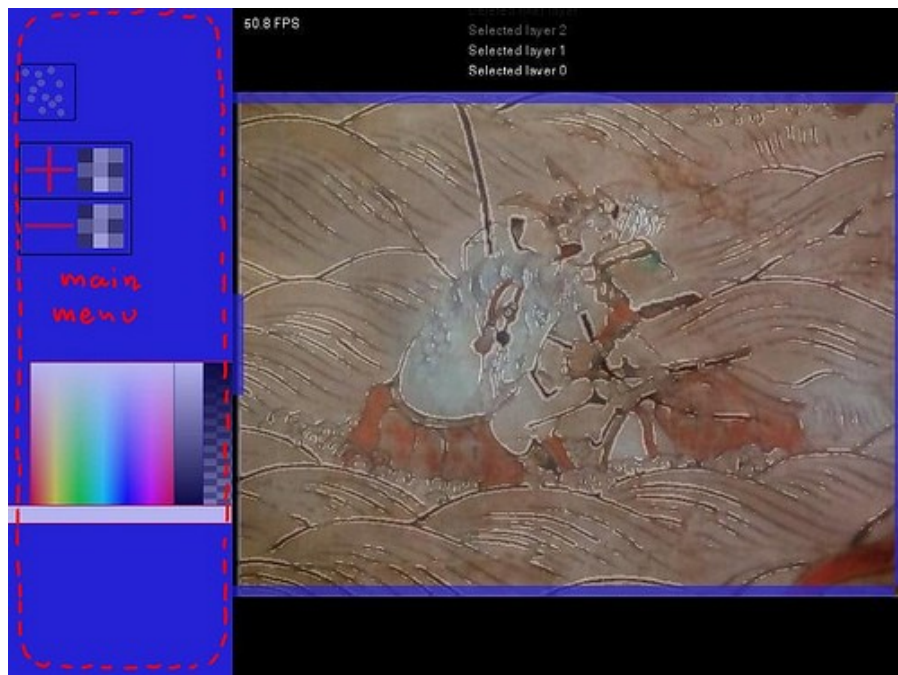
The current layout of the main menu is quite provisional at this point, and will change substantially in future releases of Andiamo. In its current form, it allows to enable/disable the GPU-KLT tracking,

add/remove filters and set the tint/transparency of the output render.

The composition in Andiamo consists in a stack of layers, with each layer drawn on top of the previous one. The initial configuration of layers is specified in a xml file (layers.xml) stored in the data folder of the sketch. At this point (version 021 of Andiamo) there is a certain flexibility in the layer arrangement, since filter layers can be added or removed while Andiamo is running. The format of the layer configuration file is as follows:

```
<layers>
    <video>layers/video.xml</video>
    <video tracked="yes">layers/camera.xml</video>
    <drawing>layers/drawing.xml</drawing>
    <osc>layers/osc.xml</osc>
    <text>layers/text.xml</text>
</layers>
```

where the type of layer is specified by the name of each xml tag: video, drawing, osc and text.

V. Video layer

The video layer is basically a two channel video mixer, which can show movies, live video captured with a camera or the output of any gstreamer pipeline. A video layer can also be used store new clips recorded in real-time during the execution of Andiamo, which will be available as regular video files. The configuration of a specific video layer is contained in the file whose file name is given as the content of the video tag in the *layers.xml* file. For instance, in the sample layers.xml given above, the configuration of the first video layer is stored in *data/layers/video.xml*:

```
<video>
    <recording name="liverec" fps="0.8" resolution="320x240" layer="final"
             codec="theora" quality="medium"></recording>
    <movie>videos/japan.avi</movie>
    <movie>videos/dave.avi</movie>
    <camera>Sony Visual Communication Camera VGP-VCC7</camera>
    <pipeline>ksvideosrc ! decodebin ! ffmpegcolorspace ! video/x-raw-rgb, bpp=32,
             depth=24</pipeline>
</video>
```

This sample shows all the tags recognized by the video layer (with the exception of the loop tag

which will be discussed in the next part of the manual in the context of the drawing layer):

- <movie> tag is used to specify a video file (is is assumed that the given path will be contained in the data folder of the sketch).
- <camera> tag is used to specify a video capture device available in the system.
- <pipeline> tag allows to enter a custom gstreamer pipeline
- <recording> tag contains the parameters for real-time rendering movie file mode

All the different elements (movie, camera and pipeline) are loaded during initialization and shown in the video layer top interface:
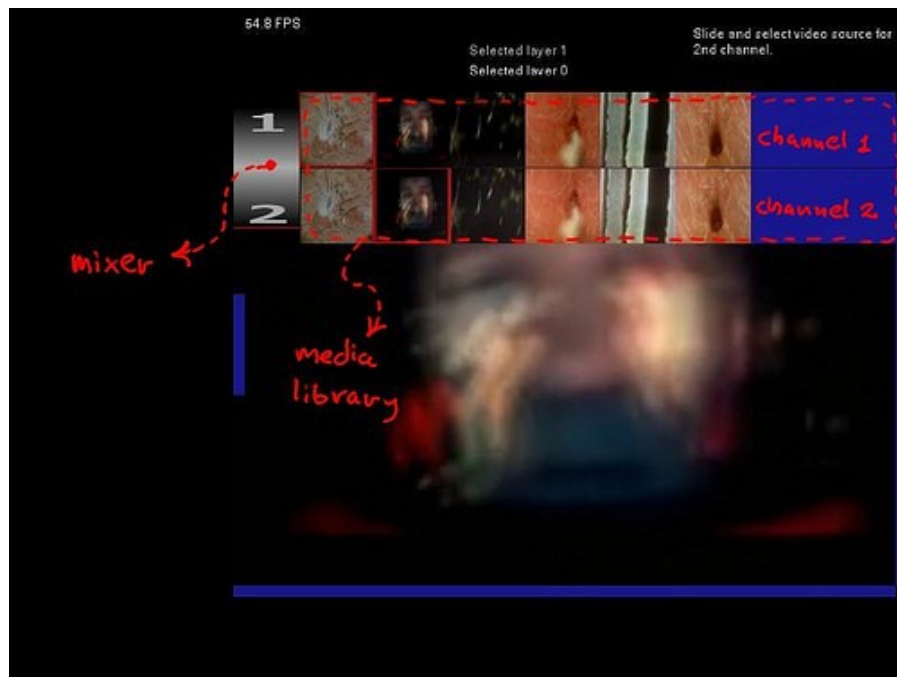
The "media library" strip allows to navigate the different video sources available and select the ones to use in the two channels of the layer. If the number of items exceeds the width of the menu, then the list can be scrolled left or right by dragging the pen (just pressing it against the tablet, or dragging with the left button pressed when using a regular mouse). The selected video sources are highlighted with a red border. Also, there is a mixer on the left edge of the menu, where the numbers 1 and 2 are drawn on top of a gray gradient. Dragging up or down the pen or mouse in that area will determine the amount of mixing between the two channels.

The bottom menu in the video layer contains the timelines and play/pause buttons for both

channels. It also contains a mixer, which works in the same ways as the mixer in the top menu. The mixing also affects the volume of the videos (if they contain audio at all), so that channel 2 is muted when the only channel 1 is visible, volume is 50% for each channel when the mixer is right at the middle, and channel 1 is muted then the mixer is all the way down:
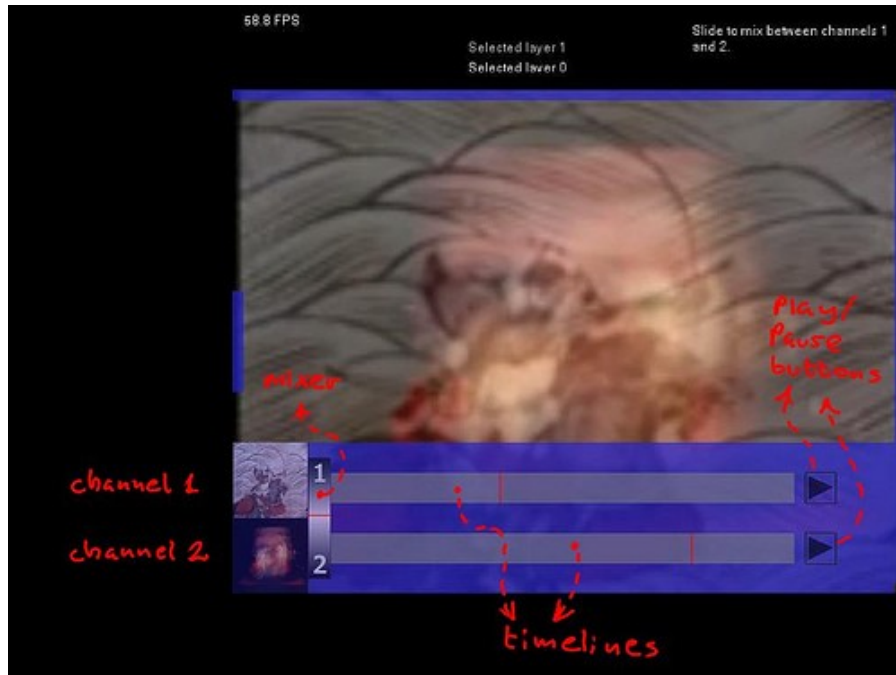
Real-time recording into a video layer it is possible when the <recording> tag has been specified in the configuration file for that layer. Recording starts and ends by hitting the ENTER key, and this will generate a new entry in the media library for the newly created video file.

```
<recording name="liverec" fps="0.8" resolution="320x240" layer="final"
          codec="theora" quality="medium"></recording>
```

The parameters in the <recording> tag control the resolution, codec and quality of the resulting file, among other things. In the example above the parameters are:

- name: the prefix given to the filename of the video file, in this case "liverec". All the recorded video files are saved into data/videos
- fps: this factor is used to compute the target frame rate of the recorded file, depending on the current frame rate of Andiamo. For instance, if Andiamo is running at 40 fps, a value of 0.8 means that the fps of the recorded file will be 40 * 0.8 = 32.
- resolution: is the width and height of the recorded file.

- layer: indicates which layer in the stack will be saved into the recording. The index is zero based, so this means that "0″ represents the first layer, "1″ the second, and so on. If the goal is to record the entire composition then the "final" should be used.
- codec: the video codec for the recorded file. Theora, x264 and xvid are available, but only theora is functional at this moment.
- quality: the quality of the video file, which can take the following values: WORST LOW, MEDIUM, HIGH or BEST.

I have noticed that some pipelines could fail to restart playing after they are paused, so I added a parameter the "continuous" parameter which could be used with any video source (movie, camera or pipeline):

```
<pipeline>ksvideosrc ! decodebin ! ffmpegcolorspace ! video/x-raw-rgb, bpp=32,
          depth=24</pipeline>
```

This parameter makes the video source to play continuously, irrespective of the status of the play/pause button.

VI. Drawing layer

This part of the reference manual will focus on the drawing layer of Andiamo. This is one of the central elements of the tool, at least in terms of live performativity. The goal is to create a system to experiment with real-time drawing which, using hand gestures as the primary input, allows to create spontaneous and dynamic compositions and animations by combining live drawing with looping and by integrating hand-drawn lines and video sources, such as movies or live camera feeds. Part of the inspiration for this integration between video and drawing comes from tools such as rotosketch, created by Zach Lieberman, Scott de la Hunta, and Susan Rethorst, from the use of the technique of rotoscoping in film and animation, as well as from my own past experiences in the theater and performance using moldeo as the software for live interpretation.

The drawing layer has a number of different gesture types: yellowtail, multi-bezier and animation. The first one is a based in the code from Golan Levin, while the second implements the

same multi-bezier fitting algorithm used in inkscape. The animation gesture allows to add cel animations to the composition and drag them around.

Gesture color and transparency can be individually selected for each gesture by using the color selector pop-up menu (while the layer color selector affects the tint of the entire layer at once). The pop-up menu is activated by pressing the pen against the tablet (or clicking the mouse) while pressing the TAB key.

In the current version of Andiamo at the time of this writing (021) there are 6 types of gestures. Each gesture type can be selected with a key, indicated between parenthesis below:

- normal yellowtail (Q): the yellowtail gesture as originally implemented by Golan Levin.
- yellowtail rotosketch (W): the first point of the gesture moves toward the last once the gesture is completed.
- yellowtail fadeout (E): the trailing end of the gesture fades out, progressively approaching the leading end.
- normal multi-bezier (R): fits the data points entered by the user with a continuous patch of bezier curves.
- multi-bezier shape (T): uses the same multi-bezier fitting algorithm as the normal multi-bezier, but the curves are rendered as a filled polygon.
- cel animation (Y): the frames of a running cel animation are drawn where the cursor is located. As the tablet/mouse is not released, then animation will follow the motions of the cursor across the screen.

Every gesture, except the multi-bezier shape, can be animated through looping. The idea of looping is basically to repeat the gesture within a specified time interval (here the term to "repeat" means to "re-draw"). The looping interval is opened and closed with the SPACE key, and everything that is drawn during the duration of the loop will be repeated periodically afterward:
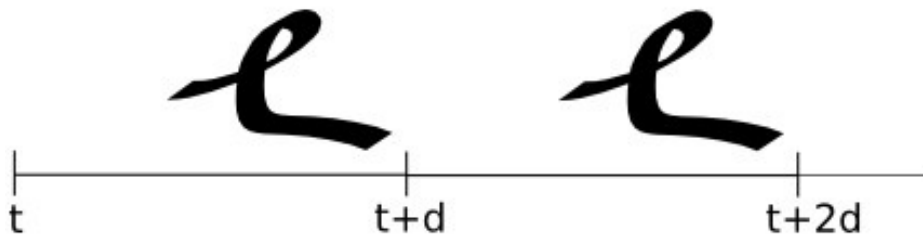
A gesture can be contained in only one loop, but a single loop may include multiple gestures. By combining and synchronizing several loops and gestures, complex animations can be achieved, basically using the gesture itself as the source for the motions. Certain gesture types have additional animation patterns, such as yellowtail rotosketch and fadeout. These motions that occur the first time the gesture is drawn will also be repeated during the subsequent loops.

Synchronizing gesture looping to a video clip is an useful feature inspired by Lieberman's Rotosketch. This feature, when enabled, triggers the creation a new gesture loop every time a clip in a specific video layer reaches the end and returns to the first frame. In the configuration file of the video layer that is to be used as the generator of gesture loops, the following tag has to be added:

```
<loop>2</loop>
```

The number is the index (zero-based) of the drawing layer that will use gesture loops generated by the video layer. The generation of loops starts/stops by pressing the SPACE key in the video layer. For this feature to work properly, only the channel in the video layer that contains the desired clip should be playing. Otherwise, new gesture loops will be created when any of the two channels return to the beginning of the clip.

Gestures can be deleted by selecting them with the eraser tip of the pen (dragging with the eraser will create a bounding box and all the gestures intersecting this bounding box are also removed), by pressing DELETE (which removes all the gestures from the layer) and BACKSPACE (which only removes the last drawn gesture). Deletion doesn't occur immediately, with the gesture gradually fading out during a pre-determined time. This deletion time can be different for each gesture, and can be set using one of the sliders in the top menu of the drawing layer. It is also possible to enable an auto-delete mode, in which gestures begin to be deleted right after they are completed. This mode can be enabled/disabled with the N key, or with a button in the top interface. These interface elements are shown in the next image:
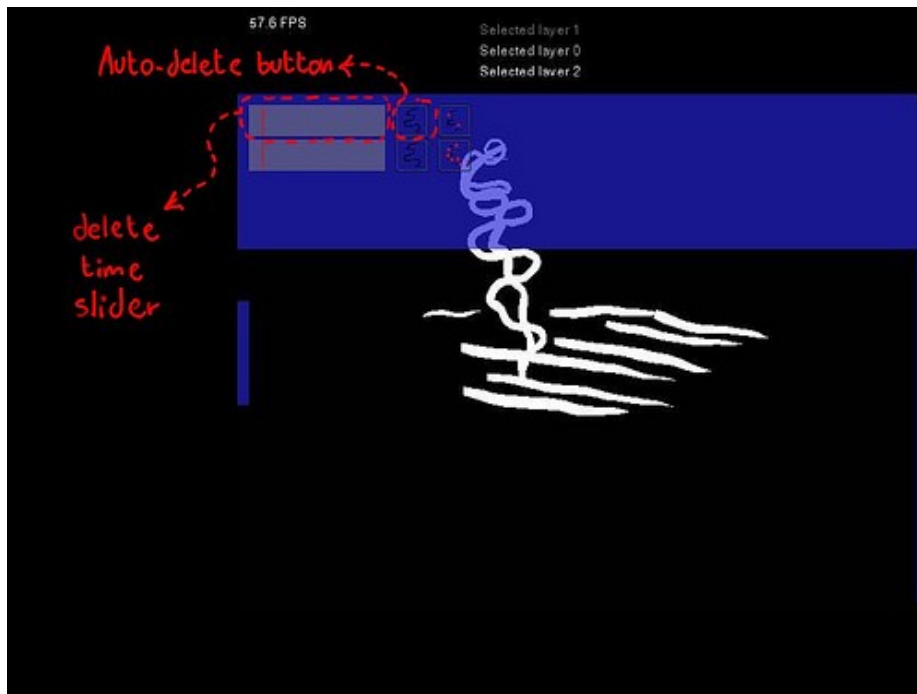
Gestures can also be hidden, which in principle appears to have an identical effect to deleting them. A gesture is hidden through with the same fade out effect used to delete a gesture, however after becoming completely transparent the gesture still exists. Gesture hiding is enabled/disabled with the 'M' key or using a button in the top menu of the drawing layer. The time that takes for a gesture to be hidden is also controllable with a slider in the top menu:

Gesture hiding can be used when looping to make a gesture gradually disappear before the ending of the loop.

VII. Animations

Andiamo allows to create animations using two techniques: cel animation and anchor points animation.

Cel (frame-by-frame) animations can be inserted into a drawing composition using the animation gesture (selected with the Y key). A drawing layer can hold many different cel animations, each one defined by a collection of individual frame images. These collections are specified in the drawing layer xml configuration file:

```
<drawing>
    <animation name="Sequential by James Patterson" prefix="PT_anim"
               extension="gif" length="12" fps="10" scale="0.5"
               playonce="no">animations/sequential</animation>
    <animation name="Falling" prefix="frame" extension="png" length="50" fps="25"
               scale="1.0" playonce="yes">animations/falling</animation>
</drawing>
```

Each cel animation is defined by the directory where all the frames are stored (in the first entry of the example above it is /data/animations/sequential, /data/animations/falling in the second). The name of the image files should have the same prefix, and numbered starting from zero: PT_anim0.gif, PT_anim1.gif,…, PT_anim11.gif, for instance. The fps parameter determines the frame rate with which each animation is played, while scale affects the size of the frames when drawn to the screen. Setting playonce to yes has the effect of stopping the animation after the last frame, otherwise it is looped.

The different cel animation loaded into a drawing layer are selected by using the LEFT/RIGHT arrow keys.

Gesture animation in Andiamo can be achieved also by the use of anchor points. These points are invisible in the final output, but they appear in the preview area. Gestures can be attached to the

anchor points so that any motion in the anchors will be transferred to the gestures. Anchor points can be generated manually or by the built-in GPU-KLT tracker. Manual anchor points are blue and tracker anchor points are red. The GPU-KLT tracker (currently supported only on NVidia cards) can be disabled while Andiamo is running with a button in the main interface:
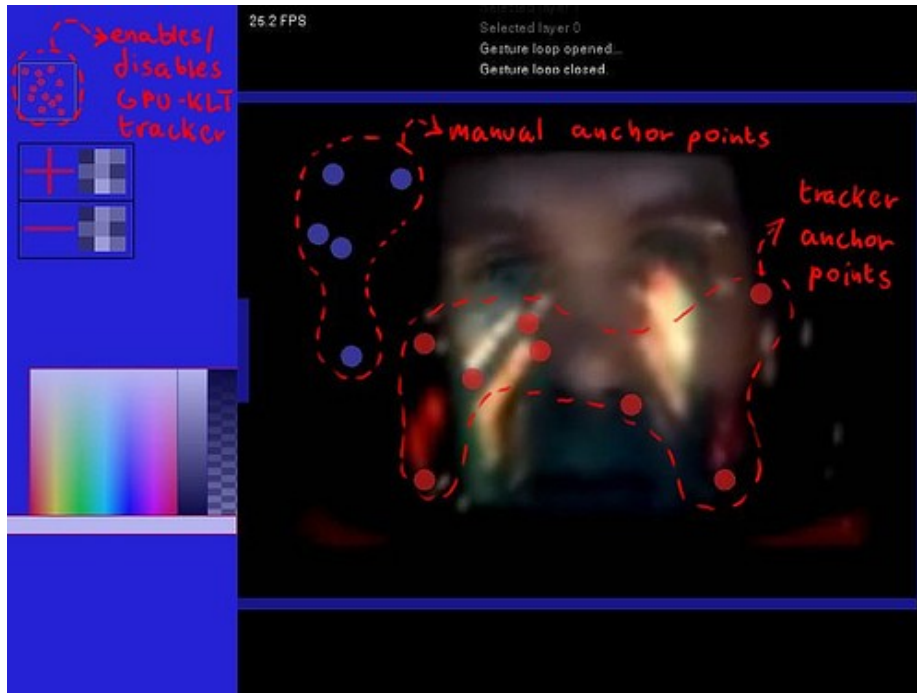
Gestures can be attached to anchors points (either tracker or manual points) with two methods:

- When drawing the gesture, it is attached to any anchor touched by the cursor. In the case of the multi-bezier shapes, all the anchors inside the shape are also used to attach the gesture to.
- After the gesture has been drawn, it can be attached to an anchor point by dragging a line between the gesture and the anchor. This dragging is done while pressing the pen button.

Tracker anchor points cannot be controlled by the user, they are automatically placed and moved around depending on the features detected by the KLT algorithm. The maximum number of tracked points can be set with the NUM_TRACKED_FEATURES global variable in the main pde file in the sketch. Higher number of tracked features would require a faster video card to run a smooth frame rates. The other important element to consider when using the KLT tracker is the video source. The video layer used as the video source for tracking is set in the main layer configuration file, data/layers.xml, by adding the tracked="yes" parameter to the video tag:

```
<layers>

    <video>layers/video.xml</video>
    <video tracked="yes">layers/camera.xml</video>
    <drawing>layers/drawing.xml</drawing>
    <osc>layers/osc.xml</osc>
    <text>layers/text.xml</text>
</layers>
```

Manual anchor points are added tapping the pen while pressing the CTRL key. Manual anchors can be connected to each other in a hierarchy (parent-child) in order to create large structures that can be controlled as a whole by moving the parent points. These structures can serve as the skeleton for a drawing composed by several gestures.

Manual anchors can be connected to tracker anchors as well, however the reverse is not possible. Also, a number of anchor points entered sequentially can be grouped together so all of them are automatically connected to the last point of the group. This is achieved by pressing the COMMA (","). All the anchor points entered afterward will be connected to the last point entered before pressing COMMA again.

Manual anchor points can be animated following an user specified curve path. The curve path is generated by grabbing the anchor point and moving it around while pressing the ALT key. The curve that results from connecting the entered positions defines a path that the anchor point subsequently follows.

Finally, anchor points are deleted by pressing CTRL and DEL simultaneously, while CTRL + BACKSPACE deletes only the last entered point.

VIII. Filter layer

This final section of the Appendix focus on the filter layers. A filter layer applies an arbitrary image transformation to the composition stack, by using the output of the previous layer as its own input for processing. The result of the filtering operation is rendered into the composition stack, and can be further processed by filters located downstream in the stack.

The filters are implemented as GLSL shaders that run on the GPU, which allows for real-time effects to be applied to full-resolution video. There are two types of filters: simple and custom. Simple filters just apply a one-pass image transformation on the input. Examples of this type of these filters are convolution filters (blur, emboss, edge detection). In terms of the implementation, simple filters can be specified as one shader operating on a single texture and generating a single output. Custom filters, such as a bloom effect or a particle system, are the result of multiple shaders running in conjunction in a specific order.

Simple filters are listed in the data/filters.xml file:

```
<filters>

    <filter>
        <config>filters/blur.xml</config>
        <icon>icons/filter_layer.png</icon>
    </filter>
    <filter>
        <config>filters/sharpen.xml</config>
        <icon>icons/filter_layer.png</icon>
    </filter>
    <filter>
        <config>filters/scanline.xml</config>
        <icon>icons/filter_layer.png</icon>
    </filter>
</filters>
```

Each filter entry contains the configuration xml file for the filter and its icon. The xml follows the format of the texture filters of the GLGraphics library. Custom filter have to be specified within the code of Andiamo as descendants of the FilterLayer class and then added to CustomFilterLayerLibrary (in FilterLayer.pde):

```
class CustomFilterLayerLibrary

{
    FilterLayer create(String name, LayerManager ilayers, AndiamoState istate,
                       AndiamoResources iresources, AndiamoMessages imessages,
                       AndiamoDynamics idynamics, Anchors ianchors,
                       ScreenRect iinRect, ScreenRect icanvasRect)
    {
        else if (name.equals("custom:bloom"))
        {
            return new BloomFilterLayer("", ilayers, istate, iresources, imessages,
                                         idynamics, ianchors, iinRect,
                                         icanvasRect);
        }
        else if (name.equals("custom:zoom"))
        {
            return new ZoomFilterLayer("", ilayers, istate, iresources, imessages,
                                        idynamics, ianchors, iinRect,
```

```
                                                icanvasRect);
        }
        return null;
    }

    final String[] names = {
        "custom:bloom",
        "custom:zoom"
    };
}

class BloomFilterLayer extends FilterLayer
{
    BloomFilterLayer(String iconfigFile, LayerManager ilayers, AndiamoState istate,
                     AndiamoResources iresources, AndiamoMessages imessages,
                     AndiamoDynamics idynamics, Anchors ianchors,
                     ScreenRect iinRect, ScreenRect icanvasRect)
    {

...
```
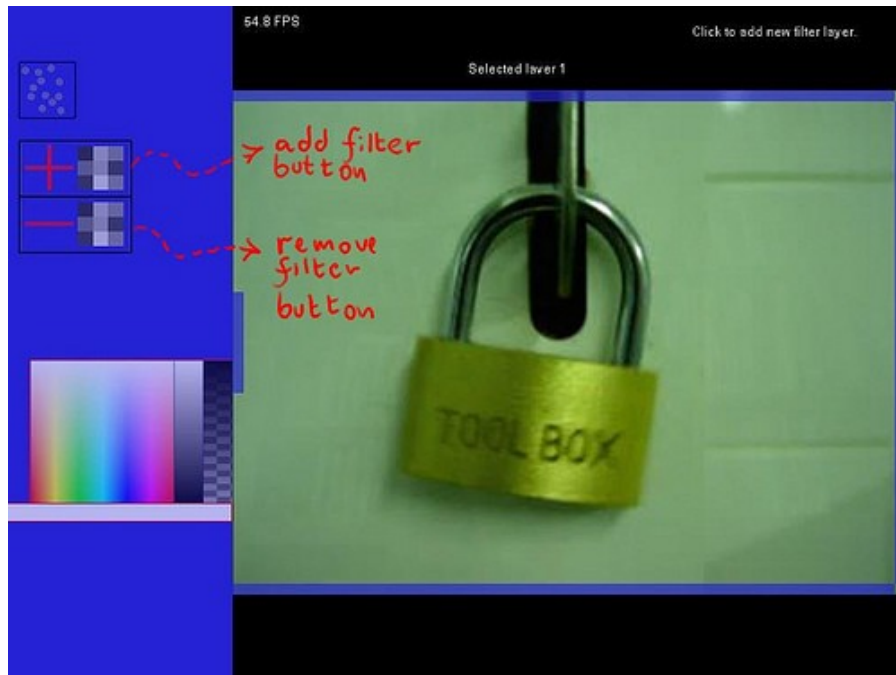
Filters can be added to the main data/layers.xml configuration file, but also while Andiamo is running using the add/remove filter buttons in the main menu:

A filter is completely transparent right after is added added, so the color selector menu of the layer needs to be used to set the transparency to the desired value.