

2018

16th Biennial Symposium on Arts & Technology Proceedings

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PROCEEDINGS

THE SIXTEENTH BIENNIAL SYMPOSIUM
ON ARTS AND TECHNOLOGY

February 15 – February 17, 2018

ammerman center

[arts & technology]

CONNECTICUT COLLEGE
NEW LONDON, CT

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AMMERMAN CENTER FOR ARTS AND TECHNOLOGY
16TH BIENNIAL SYMPOSIUM ON ARTS AND TECHNOLOGY
"INTERSECTIONS"
FEBRUARY 15, 16 AND 17, 2018

Schedule of Events, Open to The Public
All Events in Cummings Arts Center, Unless Otherwise Noted

Keynote Address: Krzysztof Wodiczko

"Open Transmission: Media Art, Public Space and Fearless Speech"
February 16, 9:30 a.m., Evans Hall

Commissioned Works:

"Nuclear Winter", Megan Young, Gregory King and Angela Davis Fegan
Feature Artists in Gallery / Exhibition
Performances: February 15, 7:15 – 7:45 p.m. and February 16, 1:00 – 1:30 p.m., Galleries

"Speculative Tourism", Shalev Moran, Mushon Zer-Aviv, Milana Gitzin Adiram
Featured artists in "Future Perfect" Exhibition, Hygienic Art Gallery, 79 Bank Street, New London.
Exhibition dates: February 16 - March 3
Opening: February 16, 4:30 - 9 p.m.

"Why Should our Bodies End at the Skin", Aurie Hsu and Steve Kemper
Featured Artists in Multimedia Performance
February 17, 5 p.m. Performance: Evans Hall

Exhibitions and Installations:

Dayton Visiting Artist Featured Exhibition: Natalie Bookchin
"Network Effects" Exhibition: January 22 - March 2, Manwaring, Joanne Tour Cummings Galleries
Artist's Talk: February 15, 4:15 – 5:30 p.m., Oliva Hall
Opening Reception: February 15, 5:30 – 7:00 p.m., Joanne Tour Cummings Galleries

Hygienic Art Gallery, 79 Bank Street, New London, Connecticut
"Future Perfect: Selected Works from the 16th Biennial Symposium" Exhibition
February 16 - March 3
Opening Reception: February 16, 4:30 - 9 p.m.

Cummings Arts Galleries
Gallery hours: February 15, 16 and 17, 9 a.m. - 8 p.m.
Opening Reception: February 15, 5:30 - 7 p.m.
Additional viewing hours with selected artists, February 16, 11:30 a.m. - 1:30 p.m., through-out Cummings Arts Center

Concerts

Multimedia Performances
February 15 and 16, 8 p.m.; February 17, 5 p.m.
Evans Hall, Cummings Arts Center

Experimental Sound Performance
February 17, 8 p.m., Tansill Theatre

Papers and Presentations

February 15, 16 and 17, 9:30 a.m. - 4:30 p.m., Oliva Hall
(Paid registration required for full attendance at the daily paper sessions)

Ammerman Center Student Project Presentations and Reception

February 17, 3:15 – 4:30 p.m., 768 Williams Street

Workshop: "#100hardtruths-#fakenews Poetry Workshop: An experiment in radical digital media literacy given the fact of fake news" Facilitators: Alexandra Juhasz, Kyle Booten
February 15, 12:00 - 1:30 p.m., Cummings 309 (Space limited, sign up required at registration table)

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Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Walking Wounded:

A living lab & multi-media performance transforming trauma through real-time drawing and sound generated from dancers' nervous system.

Heidi J. Boisvert

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Abstract

Walking Wounded is a living lab & multi-media performance transforming trauma through real-time drawing and sound generated from performers' nervous system and unique gesture vocabulary. It gives expression to unspeakable personal and collective experiences of trauma through movement, sound and imagery, and transforms the unbearable pain and toxic shame lodged in the body through somatic release using bio-adaptive play. The project seeks to restore interpersonal connection non-verbally in a safe environment, foster resilient communities and bring movement into movement building through a four-part co-design process, culminating in a local performance. Working with dancers and non-dancers who have experienced different forms of trauma, we use multi-modal movement workshops to generate the raw material for a non-linear, constantly evolving narrative, along with sonic vibration to realign damaged attunement systems amplified through sub-woofers and set to Solfeggio frequencies.

Keywords

Dance, electronic music, biosensors, generative images, machine learning, database aesthetics, trauma, somatic system, collective narrative, biomedica, networked performance

Introduction

Most rape victims, combat soldiers and children who have been molested become so distressed when they think about the experience they split off or numb the intolerable pain as a survival mechanism to move past the trauma.

Trauma is not stored as a narrative with an orderly beginning, middle, and end, but as flashbacks that contain fragments of experience, isolated images, sounds, and body sensations that initially have no context other than fear and panic. While the mind often lacks a story that can be clearly communicated, trauma is re-enacted and wreaks havoc on the body in one's immune system, muscle and nervous system. Memory cells in the immune system can lead to the auto-immune system being compromised, whereby the

body attacks itself.

Because trauma is a contraction held within the somatic system, we are often "shaped" by terrifying experiences; they inform our worldview and impact our sense of identity, intimate relationships, physiology, emotions, behavior, perceptions, and feeling of belonging. Trauma is both an individual and a community experience.

We are also deeply impacted by systems of oppression, such as racism, misogyny and poverty, which are pervasive and when experienced chronically have a cumulative effect that is similarly life-altering, as well as intergenerational and epigenetic.

Many activists-artists working on social justice issues, like me, are walking wounded. The issues we seek to end often reflect our own unaddressed trauma. Facing the reality of and healing from trauma are essential to building effective movements and systemic transformation.

Walking Wounded gives expression to unspeakable personal and collective experiences of trauma through movement, sound and imagery and attempts to transform the unbearable pain and toxic shame lodged in the body through somatic release using bio-adaptive play. The project seeks to restore interpersonal connection non-verbally in a safe environment, foster resilient communities and bring movement into movement building through a four-part co-design process, culminating in a performance.

Methodology

Erasing awareness and cultivating denial are often essential to survival. Over time, however, these defensive strategies which numb shame often cause those who experience trauma to lose track of who they are, of what they are feeling, and of what and whom they can trust. Through music and imagery generated from the inaudible sounds of both the dancers' inner bodies, their somatic and autonomic

nervous system, the piece seeks to *compose* the fragments and re-animate the life force that lies within each of us, but is often blocked or shattered through painful life experiences. Sonic vibration amplified through an array of carefully placed sub-woofers, and set to Solfeggio frequencies serve to realign attunement with oneself and one another.

Walking Wounded explores the delicate issue of trauma through collaborating with both trained dancers and trauma survivors to generate the piece, as well as with subject matter experts on trauma to design pre and after care models. Initial theoretical research on movement and neuromuscular patterns of emotion is being further examined phenomenologically through the iterative creation process with the choreographer, Pauline Jennings. We develop deeply unconscious physical postures, both neuromuscular and energetic, as children as the limbic system is still forming between the ages of 3-7, which can give rise to embodiments of feelings and chronic mental states. Trauma, too, contributes to these somatic markers. Our unique postural signatures are often an attempt to inhibit feelings that are difficult for us to bear, and yet are entirely outside of our awareness. Like our mental life, much of our physical life, sensations, feelings, gestures, movements, contractions, releases, expansion, operate outside of conscious awareness.

But this deep patterning in the body can often undermine our capacity to lead full and healthy lives. Our physical body interfaces to more subtle interior worlds, and plays a critical role in our transformation of character. Yet, dance and performative gesture, specifically, carry the potential to *rescript* our nervous system, our postural signatures, through breath, realignment and alternate movement habits. In short, language is post-kinetic, as Maxine Sheets-Johnstone forwarded. We, therefore, possess the ability to reproduce culture through the performing body. If motion emerges out of emotion, then the opposite is also true; we can transform emotional states through activating new sensory-motor routines as a result of free, unguided bodily expression.

Working with dancers and non-dancers who have experienced difference forms of trauma, this project attempts to re-pattern the nervous system through a four-part co-creation process, which consists of:

- 1) Workshop Series (sensing) to enhance somatic awareness, create new sensory-motor routines and establish a shared gesture vocabulary through contact improv, embodied games and multi-modal story circles.

- 2) Open Rehearsals (visioning) to connect personal experiences to collective narrative of trauma to transform embedded scripts, historical patterns and systemic oppression into live drawings and music generated from the survivors' muscles, heartbeat, bloodflow, temperature and motion data.

- 3) Multi-Media Performances (prototyping) to broaden awareness of the cumulative toll on individuals, communities, and movements and cultivate empathy in audiences through mirror neurons and a post-show dialogue.

- 4) Open-Source Framework & Tools (scaling) to extend the process to other social contexts and countries, enable communities to self-organize, replicate and reinterpret approach, and inspire a global movement.

To ensure our process does not re-traumatize participants, a critical dimension of *Walking Wounded* revolves around establishing strategic partnerships with leading non-profit and cultural organizations to co-design the workshop series, cross-issue rehearsal process and pre and after care models for performances.

Living Lab

A core aspect of the development process is the living lab—a sensitively designed 2-day multi-modal workshop, which we conduct through partnerships with local organizations working with survivors of sexual assault, refugee resettlement, combat veterans and foster care teens. The workshops consist of movement prompts and story circles, and culminate in a short performance. The purpose of the workshop is to enable participants to connect personal experiences to the collective narrative of trauma by transforming embedded scripts, historical patterns and systemic oppression into live drawings and music generated from the participants' muscles, heartbeat, blood flow, temperature and motion data. Movement prompts seek to enhance somatic awareness, create new sensory-motor routines and establish a shared gesture vocabulary from which to generate choreography. The unique gestures of participants are also mapped to a database of kaleidoscopic images through a machine learning algorithm. Story circles, both verbal and non-linguistic, generate raw material for the database as well as *storied objects*, which consist of custom electronics inside 3D-printed objects that trigger voice-recordings of memories through touch. The 3D scans are objects of significance brought by the participants to give away at the workshop. Through the process, participants contribute to an ongoing palimpsestual experience to transform trauma, expand their own gesture vocabulary through kinesthetic engagement, as well as gain knowledge of open-source software and hardware used to create biomedial for networked performance.



Live Performance

The final multi-media performance will be generated with the [XTH Sense \(XS\)](#), the world's first biocreative instrument and next evolution in sensory expression, which my collaborator Marco Donnarumma and I have been developing for the past 4 years. We created the first wireless prototype for one of my previous works, [\[radical\] signs of life](#) through funds from the Rockefeller Foundation. The XS captures mechanical muscle sounds at the onset of muscular contraction, as well as blood flow, body temperature and spatial information. The XS amplifies these sounds, extracts salient features, then maps them to musical and visual parameters. In this case, they will be interfaced an open-source live drawing application developed by Maria Mishurenko & Gordey Chernyy and Max/MSP custom applications created by the sound designer Kevin Patton to explore the spatial and sculptural aspects of sound, as well as thresholds generated through touch between the dancers.

A combination of contact improvisation and responsive choreography is employed as a means to both maintain the autonomy of the dancers, as well as to emphasize touch, breath and alignment. Contact improvisation is a partnering dance form, which focuses on skills such as rolling, releasing, giving and supporting weight, expanding range of spatial concentration, lifting, catching and falling all help one move with and through gravity, share weight in motion and use momentum and flow in physical contact. It focuses on body awareness: mindfulness, sensing and collecting information. Typically performed without music, and by two or more people, maintaining physical contact while moving freely. Responsive choreography similarly encourages self and other awareness, as well as builds trust in one self and the environment. Those who have been traumatized often lack a feeling of being safely and securely held, and as a

consequence self and other trust and respect.

Each participant-performer wears two XS sensors. The biophysical and motion data stemming from the XS is then be sent over OpenSoundProtocol (OSC) and mapped real-time to both the live drawing application (either directly or through a midi controller) and the musical and spatial parameters in Max supplemented by Ableton. This enables the participants to co-create live drawings real-time through their unique gesture vocabulary in collaboration with the machine learning program, as well as generative musical composition. I see visual, sound and lighting artists as performers in addition to the audience.

In addition, a machine learning application and database will map the movement patterns generated by participants in the workshops (based on Irmgard Bartenieff's Fundamentals) to a library of generative shaders, brushes and images associated with the fragmented narratives that emerge from the story circles. These live drawings will be projection-mapped onto reconfigurable screens on wheels moved by the performers to form a loose narrative. Storied objects holding lyrical fragments of memories shared by workshop participants trigger non-linearly, creating a polyphony of voices, as audience performers and members pick them up during the performance, adding a layer of emergence and fragmentation to the experience.

The set and lighting organically support and balance out the technical infrastructure as well as underscore the inner world of depersonalization, fragmentation and projection. The audiences' internal experience arc mirrors the in medias res interior landscape of trauma, traveling from stimulus confusion to positive disintegration, eventually arriving at presence of being—a place of absorption where one is not grasping for meaning through pattern recognition, but viscerally embodying the experience—raw energy and matter—beyond the self.

The goal of the performance is to create a communal space of ritual where ghosts are externalized into sound and image—exorcised—and healing takes place.

Technology

XTH Sense is a plug & play, hackable biocreative instrument & next evolution in sensory expression. The XS captures mechanical muscle sounds at the onset of muscular contraction, as well as blood flow, body temperature and spatial information. Through intelligent algorithms, the XS amplifies these sounds, extracts expressive features of your body: movement dynamics, muscular energy and temperature changes and establishes a pathway to interact with connected devices, musical and video software, games and virtual reality in a highly personalized and engaging way.



Anticipated Outcomes

The "night sea journey", a common trope explored by Jung, is the journey into the parts of ourselves that are split off, disavowed, unknown, unwanted, cast out and exiled to the subterranean world of consciousness. The aim of the four-part process and culminating performance is to similarly reunite us with ourselves. Such a homecoming can be as Stephen Copes has noted, "surprisingly painful, even brutal. In order to undertake it, we must first agree to exile nothing."

Walking Wounded seeks to create a safe and experiential environment in which dancers, survivors, and even audience members can work together to integrate split off parts of the self and to heal damaged attunement systems through training in rhythmicity and reciprocity. As Copes has keenly observed, "a self cannot exist as a cohesive structure apart from self-object experiences, without them, we cannot generate an inner experience of well-being. The very foundation of equanimity is the capacity to soothe the self, and this capacity we can only internalize through having been safely and securely held and soothed ourselves...all human beings who have developed the capacity to be an abiding presence can transfer this capacity in a kind of *cellular, visceral way to others who don't have it*" (emphasis mine). Being in synch with one self and others requires the integration of body-based senses—vision, hearing, touch, and balance. Treatment for trauma survivors needs to address not only the imprints of specific traumatic events but also the consequences of not having been mirrored, attuned to, and given consistent care and affection: dissociation and loss of self-regulation. The most devastating long-term effect of this shutdown is not feeling real inside. Biomedia, performative gesture and socio-collaborative play can restore attunement and mirroring. Dance activates mirror neuronal engagement and music fosters a sense of attunement through sonic resonance and communal pleasure. The creation of a safe and supportive space for kinesthetic engagement and interpersonal connection affords one an opportunity to overcome the unbearable sense of separation and transform destructive tendencies into the joyful play of a child.

Gesture also plays a critical part. It can be communicative,

instrumental and/or aesthetic. Adam Kendon defines "performative gesture," specifically, as a "learned shape or sequence that not only indicates, but instantiates, embodies a request, a plea, an offer, an invitation, a refusal." It is, therefore, hypothetically possible to bring new awareness to the body through new routine gestures, disrupting social conventions and dislodging painful embedded memories. In *Agency and Embodiment*, Carrie Noland supports this assertion. She sees the body as "a sensorium extending itself prosthetically through gesture into the world."

For Noland, gesture functions as a "nodal point where culture (the imposition of bodily techniques), neurobiology (the given mechanics of a human sensorimotor apparatus) and embodied experience (the kinesthetic experience specific to an individual body) overlap and inform one another." Specifically, Noland interrogates the interoceptive system, which entails the physiological condition of the body; it is the 'material me' that enables visceral afferent information to surface in awareness and affect our behavior, our moods, emotions and general well-being.

The XTH Sense supports a particular type of performative gesture. Because the XS does not rely upon an external object as an instrument, but instead the performers own muscle fiber, her own body, it moves beyond instrumental gesture, acting only upon the external environment. Instead the performer acts within and responds to her own intimate, bodily milieu. Operating on the level of the body's viscera, the performer's conscious sculpting of muscular tension and heightened articulatory sensitivity creates, in a sense, a direct pathway to the interoceptive system itself. In essence, my intent is to employ the XS to quiet the participant-performers' (and by extension the audiences') sympathetic nervous system through bio-feedback to neutralize stress and to rebalance the ecological assembly process, thereby creating an optimal environment for memory system consolidation, and ultimately psychic re-integration.

Conclusion

Many aspects of *Walking Wounded* have been challenging. The most difficult, however, was building in pre and after-care models with psychologists and other somatic practitioners to ensure that we do not re-traumatize participants during the multi-modal workshops. The piece has also forced me to challenge my own assumptions about and approach to social practice, to find the balance between honoring personal experiences while simultaneously abstracting the individual stories into a collective shared narrative.

Over the past year, we have also been building and interfacing various custom tools (live drawing, machine learning, sound system) that will drive the performance, but also be harnessed in the workshops, as both a means to expand the gesture vocabulary of the participants, and also begin to

build the database of gestures, images, and sounds associated with the stories.

For the next 6-9 months, we will continue to hold multi-modal movement workshops across the country with different affected communities and non-profit partners and begin integrating these tools in the experience design.

I am also currently experimenting with non-linear narrative devices to seamlessly integrate: 1) movement abstractions that signify traumatic events, 2) live drawings, and 3) storied objects with which performers and audience members can interact. As a result, a narrative arc and musical score is slowly surfacing that moves participants from stimulus confusion to positive disintegration, arriving at presence of being. This insight has pivoted me towards exploring ways to establish a process of shared ritual between the performers and audience that ethically instigates what Kazimierz Dabrowski labeled “positive disintegration;” a perceived state of over-excitability that is symptomatic of an expanding consciousness. Disintegration, Dabrowski claims, is the first stage of individuation away from the “illusion” that various forms of authoritative systems (which we internalize as the super ego) instill as a form of social control.

To comprehend this neurophysiological process, I have begun an excruciating phenomenological inquiry into my own trauma. From this, I have gleaned that it is here, beneath the layers of protective social armor, when the numbing mechanism no longer work, our autonomic nervous system shuts down catalyzed by the shame-shudder coupling, and mental dis-ease ensues, that we can restore our capacity to re-become a fully integrated human being.

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Author’s Biography

Heidi Boisvert (PhD) creates groundbreaking games, web/mobile, AR/VR and transmedia storytelling experiences for social change, as well as large-scale networked performances using bio-creative technology. She co-founded XTH, a startup that invents novel modes of expression through technology and the body. She is a Harvestworks Fellow and an MIT research affiliate whose work has been featured in Kotaku, TIME, Wired, Salon, Fast Company, Washington Post, and the Atlantic, and shown at EMPAC, Banff, Queens Museum, Kunsthalle and Waag Society.

Key Collaborators

Pauline Jennings is compelled to solve critical questions through her body and its relationship to others via responsive systems. Her choreography is aimed at providing a visceral journey for both dancers and audience that reflects a rapidly changing society. Pauline has presented work at SFMoMA, Merce Cunningham Studio, Museumsquartier Wien and Eastern Bloc (Montreal). She has lectured at UC Berkeley, Mills College, Institut Intermediaire (Prague), Univ. of Applied Arts (Vienna) and NYU-Shanghai.

Kevin Patton (PhD) is an artist and speculative designer whose primary mode of making is through creating interactive systems. He is active in the fields of multimedia theatre, experimental music, collaborative design, and interactive art. Kevin is also a frequent collaborator in installation, network art & performance art projects. He is an Assistant Professor of Interaction, Washington University.

Decoder 2017: Cutting Up the Reality Studio

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ABSTRACT

For the Ammerman Center's Biennial Symposium on Arts and Technology, Creator/Director Mallory Catlett, Sound-artist/Performer G Lucas Crane, and Dramaturg/Scholar Alex Wermer-Colan will present their ongoing project, *Decoder 2017*, a three-part concert series exploring the language and prophecies of William S. Burroughs on the merging of body, media, and machine. In the early 60's and 70's, Burroughs wrote an elaborate set of instructions, encoded in novels and essays, for how to use technology to escape control – psychological, societal, political. What emerged was a prophecy of and defense mechanism against the incipient technological takeover of the human nervous system.

Decoder 2017 acts first and foremost as a cut-up machine that follows Burroughs' instructions to confront the physical (and virtual) sensation of living today. The performance apparatus is turning out concerts, one for each book of the "Nova Trilogy" (*Soft Machine*, *Ticket That Exploded* & *Nova Express*). *Decoder* is manipulated, or played, by cassette-tape DJ Lucas Crane and performer Jim Findlay, who act as both fictional characters and real-time systems operators, cutting internet debris into kaleidoscopic dreamscapes, prophetic pronouncements and obscene routines that expose our complicity in the systems that control us. At the heart of the machine is an interface connecting the DJ via sensors on his tape decks to an array of technology that allow his analog body to control digital imagery.

For each concert the *Decoder* machine is augmented to mirror Burroughs' evolving literary techniques in the 1960s. Whereas *Soft Machine* experiments with more rudimentary cut-up practices, producing a violent barrage of visual

and auditory juxtapositions, *Ticket That Exploded* deploys Burroughs' fold-in method, generating kaleidoscopic images, folded down the middle and triangulated. As we craft the final part of the series, *Nova Express*, we are experimenting with new feedback systems, as well as immersing the audience with 360-degree video. All these techniques are designed to induce visual hallucinations and a sense of enclosure within the system we are creating. At the Ammerman Center's Biennial Symposium, we will present an overview of the *Decoder* project, its method and purpose, along with videos of previous shows, and Lucas Crane's live demonstration of his technique and practice.

Inspiration: The Lonely Young Tape Artist G Lucas Crane

"I'm trying to fix it so we both can listen at once. . . . Here, hold this phone to your ear. Do you hear anything?"

"Yes, static."

"Good."

- William S. Burroughs
The Ticket that Exploded, 1967

Before I was a 'musician,' I was a young poet and a literature student. I studied Oulipo and William Burroughs expressly out of an interest in cut-up methods of writing, hoping to 'sincerely' understand how the human mind translates and synthesizes its influences. I was inspired by the character in Burroughs' "Nova Trilogy" who breaks into the "Reality Studio" and splice a tape into the "reality film" feed to break the mind-control of the ruling class. At the time of Burroughs' writing, in the 1960s, tape recorders were *the* way to fight the hegemony of

reality via a simple principle: recording something “fixes its nature”, gaining dominance over time (because it cannot be forgotten), but losing the chance at re-interpretation (recordings are made for a reason, and those reasons become self-fulfilling).



These techniques, borrowed from books of the 1960s and transported to the 90s, completely took over my life. I became the tape manipulator, dealing with anti-temporal and anti-fidelity operational aesthetics in musical collaborations. The tape equipment became a musical instrument for me; Burroughs' technique to 'examine and screw with reality' fed directly into reconstituted media turntablist DJ practices. My practice became a means to deal with aesthetic brainwashing. The methods of characters in the “Nova Trilogy” to fight alien-invaders increasingly possessed stark contemporary usefulness in the era of social media driven internet culture.

Now, working on *Decoder 2017*, I can't shake a lingering sense that I've become a character in the “Nova Trilogy” - the Subliminal Kid. The title, “Decoder”, is taken from Muscha's 1984 West German film of the same name, a movie inspired by Burroughs' 1970 manifesto, *The Electronic Revolution*, instructing youth to use tape recorders to wage guerilla warfare. In the film, Burroughs actually appears in the role of a tape repair technician. Its plot is consumed with the spiritual and social consequences of artistic experimentation and discovery, mirroring what I experienced as a young ‘noise’ musician in the first decade of the new millennium. I realized that the power to break reality is within anyone's grasp, and that the tech necessary to do so is cheaper and more plentiful than most think. It's only a question of technique and mindset.



There is a scene in the original *Decoder* film where the protagonist, Jaeger, kills a frog and records its death croak. He uses tape equipment to loop and explode the garish sound into a complex musical tableau with magic effect. Five years before I saw this movie, I had already been making this sort of music. These techniques have become a basic aesthetic approach for the young artist today, awash in constant mind-gripping media. Burroughs' methods, perhaps fanciful and experimental at the time, are almost natural now, the common-sense avant-garde approaches necessary today. In the movie, Jaegers' discovery is dark magic. To me, he was a reasonable noise punk from, say, Columbus or Oakland.

The title's tag, ‘2017,’ situates the project in time. When we named the piece back in 2015, it was meant to evoke a futuristic prophecy. At the time, I had a rather prophetic dream that 2017 would be ‘the omen year,’ one of dire portent. I had no idea it would mean the election of Trump. Today, the “Nova Trilogy” and its techniques are suddenly shockingly relevant.

Conception: Theater for New Media

Mallory Catlett

Question: *Is the ability “to see what is in front of us” a way of escaping from the image-prison which surrounds us?*

Burroughs: *Very definitely, yes. But this is an ability which very few people have, and fewer and fewer as time passes. For one thing, because of the absolute barrage of images to which we are subjected so that we become blunted. Remember that a hundred years ago there were relatively few images, and people living in a more simplified environment, a farm environment, encounter very few images and they see those quite clearly. But if you're absolutely bombarded with images from passing trucks and cars*

and televisions and newspapers, you become blunted
and this makes a permanent haze in front of your
eyes, you can't see anything.

- William S. Burroughs
The Job, 1969

I met Lucas Crane in 2006; *Decoder* is the third large-scale work we have made together. One of the things we had in common was our interest in Burroughs. I had previously created a performance about Burroughs' early mentorship of and friendship with Kerouac and Ginsberg. While Lucas' connection to Burroughs was first through the "Nova Trilogy," I was primarily fascinated by where his ideas came from - Rimbaud, Reich, and Korzbiniski's general semantics. I felt these writers and thinkers offered the preparation I needed be able to read Burroughs' experimental fiction, the novels that came easily to Lucas, but for me were almost impenetrable. The connection Burroughs made between time, language and the destructive impulse would become the primary interest of almost all my work. "Man is a time-binding animal," said Korzbiniski in his encyclopedic master work, *Science and Sanity*.

The project that led to *Decoder 2017* was a piece about time and memory, a remix of Chekhov's *Uncle Vanya* for four actors over sixty years old, and Lucas, an analog tape DJ. The entire script existed on cassette tapes, the recorded voices of the actors that Lucas mixed live. We did the same with video and images of the actors, enabling them to improvise vocally and physically with past versions of their selves. To do so, we developed an interactive system whereby Lucas manipulated and remixed video content through sensors on his tape decks. In the process, we discovered a system that could make digital content responsive to the analog body.



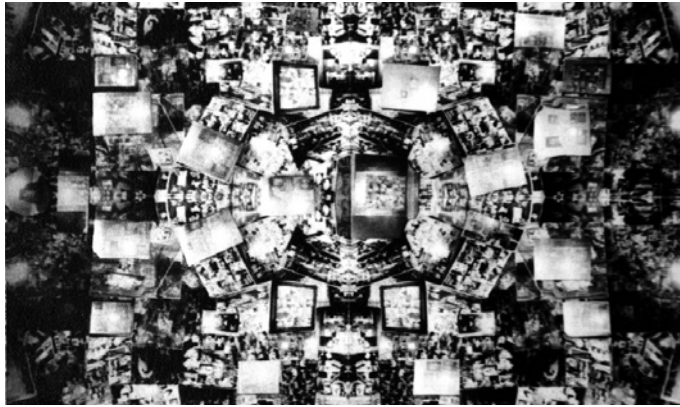
After this five-year exploration of the past, I wanted to look forward, so Lucas and I dreamed up *Decoder 2017*. Along with Keith Skretch, our video designer, we invited performer Jim Findlay to join, the other person I knew who was profoundly influenced by Burroughs. Jim's interest was in Burroughs' last trilogy of novels (*Cities of the Red Night* (1981), *The Place of Dead Roads* (1983), and *The Western Lands* (1987)), as well as his collaboration with Brion Gysin to develop the Dream Machine - a device composed of a record player, a lightbulb, and a perforated cylinder that, through flickering light on closed eyelids, induced hallucinations and expanded consciousness. *Decoder* draws, then, from our collective knowledge of Burroughs' early, mid and late career work. In 2017 we further expanded by teaming up with writer and editor Alex Wermer-Colan, whose extensive archival work on Burroughs and critical scholarship in literary and media studies have helped contextualize our work for audiences both familiar with Burroughs and new to it.

Work on the project began in 2015 in New York City and has been developed through residencies, festivals and one-off concerts. *Soft Machine* and *Ticket That Exploded* - the first two concerts - are complete. With each concert we expand and augment the system to mirror the evolving literary techniques that Burroughs was experimenting with. *Soft Machine* has more rudimentary cut-ups, and is visually a more violent barrage, whereas *Ticket that Exploded* uses the fold-in method, producing kaleidoscopic images, spliced down the middle and triangulated into new formations. We are currently devising the final concert, *Nova Express*. We hope to experiment with new feedback systems and to incorporate 360-degree camera technology to invert our setup, shifting its relationship to the audience by placing the viewer, both during performances and in video replays, at the center of the phantasmagoria. As the project has found new resonance in the current political arena, we have increasingly cut in more political speech and partisan visual content. In the biological language of Burroughs, we now see our job as inoculating ourselves and the audience in the time of Trump against the virus he has shown we both carry and

spread. The full concert series will premiere in 2019 at the Chocolate Factory in New York City.

Diagnosis: Decoding the Virus

Alex Wermer-Colan



Language is a virus from outer space

- William S. Burroughs
The Ticket that Exploded, 1962

I am attempting to create a new mythology for the space age.

- William S. Burroughs
Les Langues Modernes, 1964

These aphorisms, two of Burroughs's most famous, are also slightly apocryphal, combining ideas and phrases that appear throughout Burroughs' cut-up work. Readers frequently interpret these gnomic utterances quite literally, as Burroughs' paranoid (and irrational) theory of "language" as a biological weapon of mass destruction, a virus sent by malicious aliens from across the galaxies.

When I first read Burroughs as a teenager, I too took these utterances at face value. Finding them a bit too far out, I was more inspired by Burroughs' brilliant, and deranged, sense of humor, his radical representation of sexuality, his formal experimentations in diverse styles, and his sardonic view of post-WWII American politics and culture. In the last few years, my research focused on Burroughs' underexplored archival materials. After editing a collection of his cut-up experiments with other writers, entitled *The Travel Agency is on Fire*, I collaborated with James Ilgenfritz and a series of

other composers to set Burroughs' prose poems to music. All these years, though, I felt something was lacking. The brilliant musical performances born out of Burroughs' cut-up experiments used relatively traditional instruments, even if in experimental ways. And while I began to understand the counter-intuitive ways Burroughs challenged the cynical readers of the American empire, I'd yet to confront how Burroughs anticipated the new forms of media, especially the internet, through which I increasingly encountered his work.

When I was brought onto the *Decoder* project in early 2017, for the first time it seemed like I'd found the outward manifestation of the images I saw in my mind whenever I read Burroughs' sci-fi cut-up novels (the kind of images Burroughs approximated in his photomontage work, such as the above image, entitled *Infinity* (1962)). I was thrilled by the way the cybernetic system enabled Lucas' analog experiments with industrial sound to manipulate Jim's refined imitations of Burroughs' vocal fry. I was fascinated by how they used an oscillator drone to produce fluctuating rainbow color effects: the Isadora video manipulation program distorted the drone's light through a cheap camera, projecting it back onto Crane, the tape artist, who acted out, in one scene, the transformative experience of "the black fruit" as narrated by Findlay. Just as Burroughs cut-up Rimbaud's poetry to produce new, postmodern texts, so the *Decoder* machine spliced documentary videos of sea creatures to generate unimaginable, extraterrestrial organisms. In the aftermath of our country's most recent spiral in a longer, slower, reactionary decline, watching *Decoder* finally brought to me a new way of understanding Burroughs' virological diagnosis of our time.

Burroughs' mythology of the "space age" isn't just a formulation of the conceivable evolution of space technology into the era of intergalactic warfare. Rather, Burroughs's cut-up sci-fi novels and essays anticipated the evolution of media technology into extra-terrestrial, digital networks whose corporatized circulation routes and cyborgian, virtual experiences enhance the spread of bigoted language and thought according to self-replicating patterns of viral contagion. Burroughs gestures towards such an insight

throughout his writing, especially in his “Appendix” to *The Soft Machine*’s third edition, published, significantly, in 1968. Burroughs explains how the virus” serves as a metaphor for the spread of reactionary ideas, causing the social body to degenerate, and ideologies to polarize into self-righteous ignorance. It is especially, the likes of George Wallace’s racist rallies and Richard Nixon’s Law and Order campaign that Burroughs has in mind when he defines “the soft machine” as “the human body under constant siege from a vast hungry host of parasites” that occupy what Freud calls the “superego,” a “parasitic occupation of the mid brain where the ‘rightness’ centers may be located” (209).

If Burroughs’ cut-up sci-fi trilogy prophesied and theorized cyberpunk modes of resistance against developing forms of new media whose terrible potential only became undeniable for our time after the 2016 election, for Burroughs, such a frightening possibility was becoming apparent as early as our country’s last reactionary turn, in 1968, especially after the Watergate scandal in 1972/3. As early as November 3rd, 1969, Burroughs wrote a letter from London to Gershon Legman, declaring: “We are witnessing a world-wide reactionary movement comparable to the reaction of 1848” (*Rub Out the Words*, 307-308). Burroughs’s theory of the viral spread of ideas cannot be understood outside the context of his pessimism about late 1960s resurgences of reactionary movements that manipulated new media networks to persuade average Americans to vote against their own best interest. As Burroughs famously put it: “every man has inside himself a parasitic being who is acting not at all to his advantage.”



Treatment: Staging a Cut-Up Machine

Mallory Catlett and Alex Wermer-Colan

As you know inoculation is the weapon of choice against virus and inoculation can only be effected through exposure.

- William S. Burroughs
The Ticket that Exploded, 1967

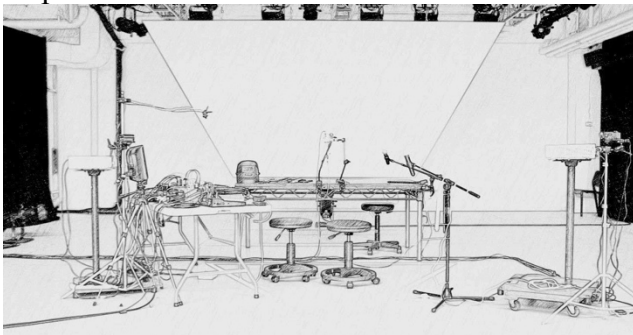
In one of his major works inspiring *Decoder*, *The Electronic Revolution*, first published in 1970, and updated after the Watergate scandal in 1973, Burroughs thoroughly theorized the development of dystopian networks capable of facilitating the viral spread of reactionary ideas. Around that time, Burroughs observed in his collection of interviews published in 1969, *The Job*, that “The mass media of newspapers, radio, television, magazines form a ceremonial calendar to which all citizens are subjected” (*The Job*, 44). In Burroughs view, we become so habituated to the “society of the spectacle” that we accept as normal a diseased state: “The word has not been recognized as a virus because it has achieved a state of stable symbiosis with the host” (*Electronic Revolution*, 6). For Burroughs, to combat the “virus of language” that spread like wildfire through the populace, the cut-up method modeled a useful antibody to descramble ideological indoctrination, de-condition stereotypical attitudes, and de-habitualize addictive behaviors. Burroughs envisioned the cut-up method as a means of challenging the ruling class’s control of the “reality film,” an image-word matrix that keeps the lower classes blinded to their exploitation, blaming the foreigner, for instance, instead of the capitalist. To challenge the reality film, however, Burroughs’ method is not straightforward: he seeks to exacerbate its lies, and to free the prisoners of their chains by revealing, and reveling, in the ugliness of the shadows on the walls of our cave.

The *Decoder* project attempts to reprocess the mass media, the viral images and words that keeps us blinded in our cave, *Decoder 2017* confronts the audience with homeopathic doses, decadent antibodies, of what Burroughs calls the “ugliest pictures in the dark room,” precisely in order to inoculate the audience against these viral

entities (*Nova Express*, 13). Ever since Burroughs started cutting up texts in the 1960s, he experimented with nearly every technological device at his disposal. He dreamed of a system that would allow for the manipulation and deconstruction of media networks like television and radio. It is, at a basic level, this task that *Decoder* attempts to surmount, creating a theatrical experience of the cut-up method proper to our brave new world of digital dystopias.



In the above still from his collaborative cut-up film, *Towers Open Fire* (1963), we can see Burroughs modeling the technologically-savvy warrior of asymmetrical war, taking on the mass media and governing class with maps, compasses, phones, and tape decks. William S. Burroughs writings offer an elaborate set of instructions, encoded in novels and essays for how to use such technology to escape control - societal, political and self-imposed. What emerged was a prophecy and a biological language for the technological takeover of the human nervous system. *Decoder 2017* is a DIY cut-up machine that follows his instructions to confront the physical sensation of living now, human evolution as he predicted.

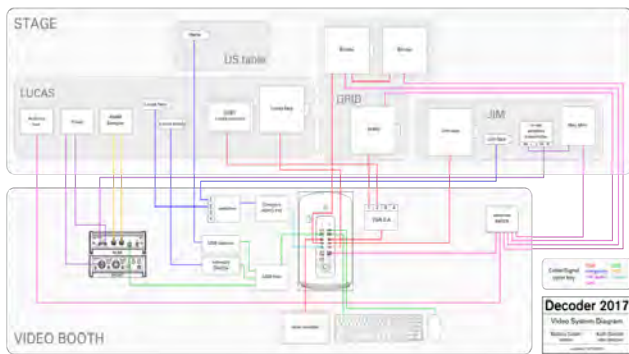


The *Decoder* set is inspired by the Gemini space capsule of the 1960's. The triangular space confines the performers to a tight but open

area, allowing our show to run in a variety of venues, from theaters, galleries to music halls. The center of the stage is a triangle taped out on the floor with tables that define the perimeter. Above there is a rhombus shaped projection screen, extending the triangle on the vertical plane. Crane's DJ rig is on the stage left table and is connected to a cascading array of peripheral devices - pedals, monitors, sensors, cameras, projectors - that feed into an offstage computer. This system enables Crane's physical action of cutting up and scrubbing tape to affect the projected imagery. There are two onstage projectors that project images into the eyes and onto the faces of the performers to create a sense of enclosure within the system. Findlay also has muscle sensors on his body that allow him to trigger and control video and sound.



The images themselves are a mixture of live feeds, original footage and internet trash created by video designer Keith Skretch. After mining the internet for evidence of Burroughs' intergalactic battle between monopolistic forces, Skretch creates the feedback systems and video editing functions that serve as a blueprint for the show, allowing Crane to cut and fold the digital moving images within the formal confines of analog tape machines. Crane and Findlay play the set list, improvising their deployment of technology to infiltrate each other's bodies in live cutups and feedback loops.



Technically the system is built around the messy and dangerous fusion of human brain with disruptive mass-media technology. Incorporating Arduino sensors, MIDI and OSC protocols, and processing through Isadora software and Max/MSP/Jitter, the system uses a customized analog-digital control interface to bridge the gap between Crane's existing audio cassette mixing rig and the computer-based video playback system. Physical sensors on Crane's tape decks allow him to trigger the Videobrain playback computer simultaneously with his tape-manipulation performance. Crane also monitors and plays the video output, responding to it with his musical manipulation. The Videobrain at times takes on a life of its own, not merely responding to the human host's commands but developing its own patterns, generating unanticipated and disruptive control signals.



Conclusion: Decoding the Reality Studio

Mallory Catlett and Alex Wermer-Colan

Decoder confronts the viewer with the only method of inoculation for our sickness, our ideological occupation by parasitical viruses, commodity fetishes that structure our desire and belief. To expose the audience to what Burroughs in his sci-fi trilogy imagined to be the antidote to the mind-control of an elite ruling class willing to sacrifice the majority for their own luxury, *Decoder* elaborates upon Burroughs' method, adapting his techniques first refined through the material of writing, and experimented with in tapes, paintings, and films, to create a multi-media performance space integrating complex analog and digital systems with cybernetic feedback between the performers (like a ventriloquist and his dummy) and between the performers and the audience.

The viewer encounters a barrage of images as the Kid (G Lucas Crane) mixes found tapes and video projections, manipulating and being manipulated by his partner in crime actor Jim Findlay, whose litany of routines, metaphysical poetry, stand-up routines, prophetic pronouncements, and surreal narrations of colonial fantasies of alien eroticism, guide the audience through a transformative experience. Such an experience is designed, like Burroughs oeuvre, to help the reader escape the prejudices of the mind that limit us to a body whose subjection to and complicity with systems of power by means of image and word control withholds us from a liberated experience of time and space.

For audiences who struggle with how to approach such a work, we recommend taking Burroughs' own approach when he studied Brion Gysin's paintings. Gysin interviewed Burroughs in 1960 at the Beat Hotel. As he scrutinized Gysin's paintings, he provided a crucial way to think through the intersection points at which *Decoder* seeks to apply pressure on our contradictory culture and times:

Brion Gysin: *How do you get into these paintings?*

William Burroughs: *Usually I get in by a port of entry, as I call it. It is often a face through whose eyes the picture opens into a landscape and I go literally right through that eye into that landscape. Sometimes it is rather like an archway...Any number of little details or a special spot of color makes the port of entry and then the entire picture will suddenly become a three-dimensional frieze in a plaster or jade or some other precious material. This picture in front of me is in four sections. The remarkable thing is the way in which the sections, when hung a few inches apart, seem literally to pull together. The substance of the paintings seems to bridge the gap. Something is going streaming right across the void. Surely this is the first painting ever to be painted on the void itself. You can literally see the pull of one canvas on the other. Now you suddenly get all sorts of things here. Beautiful jungle landscape. And then always bicycles. The whole bicycle world...scooters. All sorts of faces...monkey faces... typical withered monkey faces. Very arche-typical in this world. And you do get whole worlds. Suddenly you get a whole violet world or a whole gray world which flashes all over the picture. The worlds are, as it were, illuminated by each individual color...worlds made of that color. You think of them as the red world and then the blue world.*



References

Artists Involved:

Creator/Director - Mallory Catlett
 Sound & Video Manipulation - G. Lucas Crane
 Video - Keith Skretch
 Interaction - Ryan Holsopple
 Performance - Jim Findlay
 Dramaturg - Alex Wermer-Colan
 Creative Producer - Meredith Boggia

Performance & Residency History: March 2015 Mount Tremper Arts Residency; June 2015 Gibney Dance Performance; January 2016 Collapsible Giraffe Residency; February 2016 *Soft Machine* performs @ PuSh Festival; October 2016 CultureHub residency; December 2016 *Soft Machine* performs @ at La Mama; March 2017 Mount Tremper Arts Residency; July 2017 *Ticket That Exploded* performs @ Mount Tremper Arts. The full concert series will premiere at the Chocolate Factory in the 2019 season.

Commissioning & Development Support: Gibney Dance; Mount Tremper; Collapsible Giraffe; Theatre Conspiracy; Playwrights Theatre Center; CultureHub; Collapsible Hole; Creative Capital; Chocolate Factory

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Big Tent

Field Testing a Portable Venue for Multimedia Performing Arts

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Abstract

Created and realized by Robin Cox and Benjamin Smith, *Big Tent* focuses on a venue design for public engagement with cross-disciplinary arts and affording artists a consistent canvas to explore. Observations are made of this portable and immersive multi-media venue from numerous public events. Other environments have been created with similar technology, but none with the portable cost-efficient goals of *Big Tent*. Different modes of performance and communication are accommodated in many different contexts, such as concerts, installations, and interactive works. Original works created and/or adapted for the Tent to this point have included multi-hour public concert events, evening length interactive installations, a week-long fixed-media installation, and numerous community dance participation events. As borne out over numerous public events, logistic, artistic, and technical outcomes are noted for this large-scale 360-degree sound and video performing arts venue for audience interactivity.

Keywords

community immersive multimedia portable venue

Introduction

Modern life is saturated by integrations of visual and auditory communication; thus, it is only natural audiences are inclined towards artistic forms reflecting, even amplifying, this reality. Artistic experiences combining sound, visuals, and movement are nothing new or novel, with traditions from opera and ballet to the circus and town parade finding appeal in both the narrative and abstract for many generations. The ubiquity of relatively inexpensive and extremely approachable media, such as television, movies, and digital games, demonstrates how so many readily identify with multimedia arts. Further, there is increasing pressure to satisfy the desire for unique, individualized experiences and giving a sense of agency to the consumer. While routine and ready access to these experiences is acknowledged, many soft barriers remain, constraining the breadth, and thus the creativity, of artistic experiences reaching the community.

The concept of *Big Tent* is borne from this desire to expand meaningful engagement between community and multimedia artistic work. The concept includes adaptability to event location, full immersion atmospherics, absence of performer/audience divisions, de-stratification of viewing angle, and rich participant interaction. Together, these elements work to create a more approachable and active audience experience, allowing artistic content to stretch beyond the mainstream and reduce constraints imposed by economic demands of the consumer marketplace.

Multimedia digital arts frequently get bound up in two questions: creativity of artistic content across mediums, and pushing technical boundaries of hardware/software as used in presentation. Both concerns stem primarily from our relatively short history of expressions in inter-media and interactive multimedia art (compared to other non-digital artistic forms). Given the need to explore the domain technically, much of the creative work becomes concerned with novel solutions, leading to an outlook seeking to validate work more on innovation than presentation, aesthetics, and experience. But, as necessary as these technical investigations are, questions of venue as artistic instrument, accessibility of live performance presentation, and how artistic content engage attendees as creative agents are all requiring more consideration and invention. By extension, when a member of the public overcomes inhibitions to *actively* participate in an arts event (as with use of handheld controllers generating visual and sound content in *Big Tent*), deeper and more sustained connections with the collective artistic content are possible. [1]

Preceding Models

This work finds inspiration from the traditions and purposes of the circus Big Top, a multi-media venue with little reliance upon existing infrastructure and an egalitarian attitude to the attendees. As a portable multi-media site, it could project its own 'aura,' [2] bringing the potential to uniquely define without accommodating other institutions (such as the elite history and stigma of the opera and thea-

ter hall). The Big Top also presented ‘in the round,’ with a central ring and multiple audience perspectives of equal quality, unlike the intentionally hierarchical seating arrangements of brick and mortar concert and opera venues. This alternate presentational model, as exemplified by the circus Big Top, has stagnated in development, while most contemporary performing arts continue to be wedded to the architecture of classical music and traditional theatre proscenium stages.

Multi-media installation artists have indeed explored concepts with surround video, projecting to multiple walls so as to encompass a gallery audience. And these surround environments do potentially subvert the idea of a privileged ‘front’ orientation and therefore require viewers to look around and move to experience the whole piece. However, while these works are novel and often explore new aesthetic ground, they are typically highly tailored to a specific physical setting (i.e. a gallery in a museum) and costly to move and reproduce. Thus, most of these pieces have a short lifespan. This is further aggravated by inherent difficulties in documenting surround video and audio experiences (due to their immersive nature), denying meaningful review and appreciation after the installation is over.

Design

A particularly novel advantage of *Big Tent* is the capacity, unlike other large scale and fully-surround environments, to be easily transported and setup in any space of adequate capacity. Construction and implementation of *Big Tent* focused on maximizing portability by minimizing setup and tear down time, crew requirements, maintenance costs, and transport costs. This provides opportunities for artistic content to be brought to non-typical audiences and environments. [3] To date, the results have found *Big Tent* presented in a school cafeteria, along the bank of an urban water canal, at a state capitol building rotunda, and in a large residential front yard.

In technical summary, it is a twelve-foot-tall, forty-foot diameter ring of eight projection screens, resulting in 1152 square feet of projectable surface (fig. 1). This is complimented by eight channels of surround audio and eight channels of HD video. The entirety is driven by audio/visual software providing a flexible interface for a diversity of artist interactions. Ultra-short throw rear projection video, wireless HDMI, and specific audio systems were employed to keep the internal area of the Tent completely free of wires and other visible technology. A single computer drives the Tent, allowing any multimedia software to treat the environment as a single 7 mega pixel surface and the sound as a single interface.

In the obfuscation of a single presentation perspective, this venue prioritizes negation of a perceived audience area vs. stage area, or the single perspective orientation of antiquated proscenium theaters. It is capable of accommodating an audience size of 40 to 60, even with two live per-

formers in the middle of the space. Furthermore, the scale of *Big Tent* allows experiencing the presentation without a sense of confinement or lack of peripheral depth-of-field characteristic common to other immersive multimedia environments. Yet, the sheer portability of *Big Tent* still meets the important goal of taking multi-media immersive presentations out into the community and away from traditional event settings.

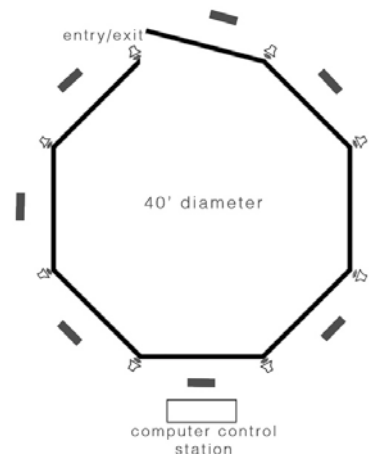


Figure 1, *Big Tent* schematic

from an exterior control station. And given its portability, *Big Tent* cannot rely upon XLR cable or grounded power floor inserts to service needs within the tent. Wireless solutions were required for transfer of microphone or instrument line level sources, yet Bluetooth and Wi-Fi were shown to be too unreliable for transfer of high-quality audio. A sophisticated UHF wireless transmission system was adequate to this need however. A power drop from above the tent was also considered but judged too heavy for the length of travel. These power needs must be met via batteries, or if absolutely necessary, cabling protected by walkovers (a disruptive element for any movement inside the Tent).

The capabilities of *Big Tent* have also allowed a companion concept, *Hourglass*, a large-scale community dance participation event, to extend into active engagement with real-time video feeds. [4] These video feeds became a contribution of processing via the software program Jitter, whereby a highly manipulated feed from a webcam of Hourglass participants in “the tent” is projected onto the video surfaces. This provides a rhythmic energy in compliment to the collective physical movements, as if the video surfaces are a hyper-realization and extension of the human participants. *Big Tent* and *Hourglass* in combination enhances the presentational priorities of both concepts, in effect acting as a meta-demonstration of this philosophical approach to community engagement with multimedia arts.

Upon initial construction in 2015, *Big Tent* began with explorations into technical and presentational aspects of having a live musician in the interior of the space coordinating with projected imagery. With the audience moving around the space, cabling became an immediate challenge, as performers could not be tethered to audio or power cables along the floor



Figure 2, Hourglass dance event in *Big Tent*

Without an overhead truss or canopy system (something hoped for in a future iteration of *Big Tent*) down lighting was still in need to supplement incidental light coming off projection surfaces. While not requiring high wattage, this additional light source serves to highlight performers and aid attendees in moving around. Many conventional solutions were unworkable with a 40-foot diameter span, and if lighting is mounted from the frame itself, lighting instruments inevitably conflict with angles for viewing projected imagery upon the video screens. The rather low cost and easily engineered solution became employing small, battery powered LED lights strung on heavy-gauge fishing wire across the top of the tent, tensioned by projection surface frames.

There are other environments created with similar technologies, but none possess the portable and cost-efficient aims of *Big Tent*. Scientific virtual reality (VR) systems are one such example, perhaps best exemplified by NASA's HIVE environment [5, 6], a portable VR display system. Yet the HIVE focuses on solving different problems, being a single user experience, necessitating a fixed viewer orientation, and being prohibitively expensive to construct. The Allosphere at University of California Santa Barbara [7], a large-scale facility for advanced research in immersive environments, provides a complete sphere of video and audio several stories tall, existing in a dedicated building. However, this space is not at all portable, flexible in application, or available to the broader community.

Public Events

A design goal for *Big Tent* was to create an aesthetically neutral venue large enough to have shared experience with the community and supporting a broad stylistic range of music, dance, and intermedia art expression. [3] It also accommodates different modes of performance and communication in many different contexts, such as concerts, installations, interactive works, and as employed in conventional facilities (e.g. museums and concert halls) and non-conventional spaces (e.g. parks, gyms, and shopping centers). Original works created and/or adapted for the

Tent to this point have included multi-hour public concert events, evening length interactive installations, a week-long fixed-media installation, a continuous reel of archival audio/video celebrating the history of the Indiana Arts Commission (fig. 3) and as a frequent container for the aforementioned *Hourglass* (fig. 2).

Big Tent proceeded into its first public events in fall of 2015, three at the Indianapolis Museum of Art, and a fourth completely overtaking the dimensions of a high school cafeteria for a science education fundraising event. At the Indianapolis Museum of Art, *Big Tent* produced day-length public experiences in fixed video, real-time video processing, and interactive video, in coordination with live music or multichannel electronic music.

These initial events, under predictable stresses of a public moving in, out, and around the tent, demonstrated the necessity of scale employed by this concept. Not only would an internal diameter less than 40 feet significantly diminish appreciation of a fully immersive experience, but at every event *Big Tent* would have been overwhelmed by the sheer number of attending people, and thus unable to function artistically. Indeed, there have been instances where an even larger diameter would be appropriate, but this would bring more daunting engineering challenges, both in computing power and in physical dynamics of the frame system.



Figure 3, *Big Tent* installed in the Indiana Statehouse rotunda

A National Science Foundation sponsored dance-for-film by choreographer Cynthia Pratt was created specifically for *Big Tent*'s enormous video projection format in 2016. [8] The other major project of the year was a commission of interactive music and video for the Indianapolis Light Festival. [9] This opportunity for outdoor presentation to thousands of people over a summer weekend was particularly notable for use of Wii controllers handed to attendees in which audio and visual content was manipulated in real-time. Conversely, this event also reinforced earlier experimentation in discovery of what environmental limits *Big Tent* can tolerate. The first evening of the festival brought a sudden rainstorm, that luckily only impacted the skeletal metal framework (leaving *Big Tent* with minor rust issues but otherwise undamaged). The second evening, while generally of much better weather, tested the capaci-

ties of *Big Tent* to sustain wind gusts. Even with ground lines tethering the projection frame, it has become clear that *Big Tent* is capable of handling wind gusts only up to 18 MPH. Despite this specific weather experience, *Big Tent* has on the whole been rather resilient to environmental conditions and durable under stress, with only minor repairs necessary after the initial twelve separate productions. Surprisingly, given the sensitivity and quality of the electronics involved, the most common upkeep expense has been replacing iron pipes and fittings that comprise the frame.

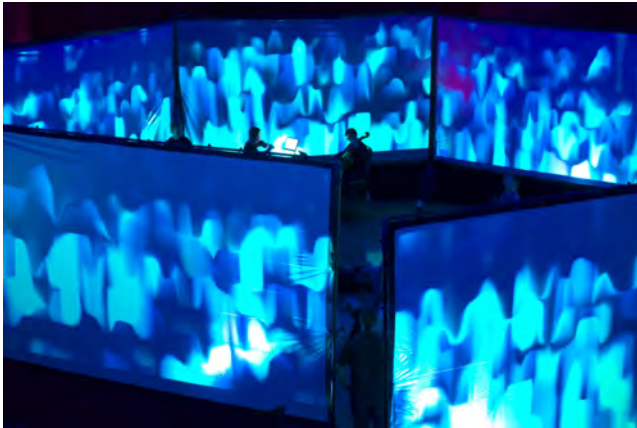


Figure 4, live violin/cello performance in *Big Tent*

With numerous public event productions to now draw conclusions from, two of the early design decisions have proven essential to early success of *Big Tent*. One, by using ultra-short throw video projectors the external diameter ring for the tent was cut from a potential 80 to 90 feet, down to only 50 feet. While the ultra-short throw Epson projector model in use is normally found mounted just in front of a wall upon ceilings of small conference rooms, with *Big Tent* these projectors are placed on the floor (upside down). The benefit comes from the fact that each projector need be no more than five feet removed from the back of a projection surface for full 16-foot-wide coverage as necessary per screen. This remarkable reduction of overall external footprint allows *Big Tent* to be erected in a great many more locations. Second, the decision to change from a full frame of steel metal piping to one of metal piping only along the top frame surface in conjunction with vertical linkage from inexpensive DJ lighting poles (akin to aluminum PA poles but of higher reach), brought an enormous reduction in frame system weight. This made the apparatus not only significantly more stable, but much more practical for setup and transport.

In a future version, *Big Tent* would benefit by two fundamental changes, though with the consequences of a much larger budget requirement. One, employing a canopy system or second exterior tent made of a heavy, non-light-permeable canvas. With the fundamental design calling for rear projection screens that are highly light permeable, even very low external light sources wash out projected visuals. This thwarts many possible concepts for use of

Big Tent outdoors, given that video presentation is not functional until after sunset. Indoor setups are also constrained if windows, security lights, or other light sources cannot be fully dimmed. An external enclosure would open many more presentation possibilities, in addition to further addressing internal lighting and weather-related conditions, through better elimination of external ambient light upon projection surfaces. Two, the presence of 2-inch seams between each of the eight video screens have, in practice, represented only a minor disruption of artistic experience (fig. 4 & 5). But, a new iteration would be improved by moving to a fully continuous (seamless) video screen design, likely made of light permeable Spandex and tethered by curved rails from above and below. This second point would result in advantages akin to how the work *Song 1* of Doug Aitken is presented. [10]

Conclusions

This large-scale immersive environment, with consideration of venue design, artistic content, and pathways for active involvement, has shown itself capable of creating compelling situations for contemporary artistic exploration, while also remaining in easy reach of the general population. This approaches the event container itself as an element of the artistic content, with walls as an interactive visual canvas coupled with surround sound audio systems. And unlike most other expensive, inaccessible, and elitist designs, which tend towards restricting audiences and artistic attempts to explore aesthetic possibilities, *Big Tent* provides a portable, accessible environment for creators and audiences alike to experience multimedia expression. Through scale and portability, the concept brings possibilities of 360° surround video, audio, and live performance to nearly any location, for a diversity of active community experiences with the performing arts.



Figure 5, 3D visuals demonstration in *Big Tent*

Additional Resources

Photos and video of *Big Tent* may be found at the following address: <http://www.thebigtent.org/AV/index.html>

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Author Biographies

Dr. Robin Cox addresses intersections of acoustic and electronic sound, collaborates with artists of other mediums, and researches

new listening methods and environments. As an active violinist, he also pursues the composer/performer model, directing The Robin Cox Ensemble in over 170 performances, three CD productions, and numerous premieres of works by other artists. He has created the large-scale community dance participation event HOURGLASS, co-invented an immersive audio/video performance venue called *Big Tent*, produced mixed-media concerts as Director and Founder of Iridian Arts, and serves on faculty with the Music and Arts Technology Department at IUPUI.

Dr. Benjamin Smith embodies post-disciplinary collaborative ideals, equally comfortable creating and working as a musician, a computer graphic artist, and software designer. His work confronts the limits of human-computer interaction and performance, seeking continually to expand the realm of aesthetic potential at the nexus of artistic technological engagement. He holds a dual appointment at Indiana University Purdue University Indianapolis (IUPUI) as Assistant Professor of Music and Arts Technology and Computer Graphics Technology. Smith came to IUPUI from Case Western Reserve University and the Cleveland Institute of Art where he led a Tele-health and Wellness research group, and taught animation, game design and development, and sound design. Active as a composer and violinist, his works have been premiered all across North America, and his ground-breaking Telematic works have joined stages across the US, Australia, South America, and Europe in simultaneous performance.

Time to Compile: An Interactive Art Installation

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Abstract—Making sense of technology is a task for creative movers. Moreover, exchange between disciplines tends to enrich each. This paper details the in progress process of a choreographer visiting a robotics lab for extended time periods over the course of years. In particular, an interactive installation has been designed that gives audience members (participants) access to this collaboration. It is one that requires a melding of vocabularies, value systems, and skills. It is also one that unearths sense-making about humanity’s relationship with technology. The paper will review both the artistic goals and the technical implementation of the installation as well as provide discussion about the process the team went through to arrive at the in progress artistic piece: *Time to Compile*.

I. INTRODUCTION

Why would a robotics lab fund a choreographers trip from New York to Illinois? Why would a choreographer come and huddle in the cornfields for four weeks? Both are trying to keep pace with technology. How we catch up, it seems, is twofold. First, classification for each new tool, e.g., this one is a computer, this one is a robot, this one is a hammer, seems necessary. However, metrics like humanness, “complexity”, “ability to move in space”, and “frequency of necessary interactions” tend to blur the line between such distinctions. We also catch up just through experiencing which occurs through moving with technology. For example, we type on a new keyboard, testing the springiness of each key by moving our fingers across the surface. Or perhaps its a new fabric, washable cashmere, that we slide our hand along to come to some understanding of it. With robots, it can be no different.

Roboticians have worked with artists for many years. Goldberg (a roboticist) has asked questions about our relationship with technology for decades, including his work with the first teleoperated garden [6], ballet dancers and geologists [7], in active museum exhibits [4], and he notes the serendipity that occurs when these disciplines cross-pollentate [5]. Cunningham (a choreographer) worked with technology throughout his career both in muscscapes [9] and in creating movement [11]. Burton and Kulic have used Laban Movement Analysis (LMA) to create intricate, life-like active sculptures [2]. Collaboration with puppeteers has highlighted challenges in nonlinear control [3, 8].

In our work, we wanted to explore a residency of a long duration and leave the charge relatively open-ended. The exchange for roboticists is rich: students could learn from a professional dance artist and practice choreographic

processes; the exchange for the artist was likewise enticing: the choreographer got a glimpse close to the machine, so to speak, and insight into the world of technology development. This allowed roboticists to explore movement design from an embodied perspective and allowed a choreographer to grapple with questions about her relationship to technology alongside its development. The result is an in progress piece, *Time to Compile*, and new research questions about how priming effects perception of robots and how choreographic tools can engender trust and acceptance. This paper focuses on documenting the efforts of the former, the artistic collaboration that has produced a unique tech-infused interactive installation.

Time to Compile is a collaboration between New York based choreographer (Catie Cuan) and the Robotics, Automation, and Dance (RAD) Lab at the University of Illinois, Urbana-Champaign, led by assistant professor of mechanical engineering (Amy LaViers). Catie spent four weeks in June 2017, in residence at the RAD Lab, teaching movement classes to the RAD Lab engineering students and co-creating this piece with Amy, a Masters student (Ishaan Pakrasi), and an undergraduate student (Novoneel Chakraborty). There was an initial showing in June at the RAD Lab at the end of this work period. Catie returned to UIUC in December for a two week work period to further develop video, dance, and written material for *Time to Compile* alongside Amy and Ishaan. There was a secondary showing of this piece on December 16, 2017 at the RAD Lab. Other lab students have given meaningful input over the course of this collaboration. *Time to Compile* has several upcoming showings in 2018, including the Biennial Symposium at Connecticut College, the Conference for Research on Choreographic Interfaces at Brown University, Arts@Tech at Georgia Tech’s Ferst Center, and the Pygmalion Festival. Images from past showings are given in Figure 1.

The paper will first outline the themes of interest in this collaboration in Section II. Then, the artistic outline of the installation will be provided in Section III and Figure 2. Then, the specific technical implementation of the vision will be described in Section IV and Figure 3. Finally, high-level excerpts from the collaboration will be discussed (both positive and negative) in Section V with concluding remarks offered in Section VI.

II. THEMATIC EXPLORATION

During the initial discovery period in June 2017, Catie spent several unstructured hours engaged in dance improvisation and

philosophical exploration with the various robots in the RAD Lab. She experimented with prototypical human intimacy behaviors, like hugs, hand holding, slow waltzing, and long stares into the robot “eye” nodes/animated screens. She wrote dialogue and programmed the NAO robot to speak the written lines with various pauses, simulating a theatrical conversation. Catie also wrote several short stories inspired by the notion of future physical and digital boundaries between humans and machines. While immersed in this exploration, she met with Amy and posed the question, “Are robots becoming more humanlike?” Amy argued that humankind’s dynamic plasticity and adaptability renders them more susceptible to psychological and physical change than robots. As a result, Amy posed the question in reverse, “Are humans becoming more robotlike?” and this question became a central theme of the collaboration.

Upon further exploration, Catie was frustrated by the needlessly opaque elements of the various technological tools in the RAD Lab. In choreography, there is a true immediacy between imagining movement and executing it in real time. While learning how to use various technological tools for the first time, Catie discovered a long, error-prone process of testing and iteration before the tools would execute movement patterns. Ishaan expressed a similar frustration while programming the various tools. The vastly different latency between human movement and machine movement became a second core theme and the title of the performance piece – *Time to Compile*. Discussions throughout the June discovery period also addressed popular media articles around machine cognition and sentience. Films like *Star Wars* cultivate the idea that machines experience the world through a semi-human consciousness. In discussion with Amy and other RAD Lab students, Catie came to agree that this is an inherently flawed idea and one that discounts human complexity relative to the mathematically limited organized transistors and motors that comprise robots. Fictional machines like C-3PO, and the contemporary artifices inspired by it, do not possess human physical or mental qualities but are computerized moving sculptures created and maintained by people. Revealing this flawed machine magic and cloaked human element became the third central theme: The hidden human network.

Time to Compile was thus created in response to three topics of concern: 1) *The Hidden Human Network*. Many technologies are powered by humans for the benefit of each other, but often this network is occluded, leaving a machine seeming quite intelligent, e.g., IBMs Watson, which is powered by the webpage postings of users all over the Internet. 2) *Are humans becoming more robot-like?* This question was originally posed in the reverse, but upon further inspection, it is easy to argue that the rich adaptability of humans is heavily exploited in emerging technologies (more than any particularly successful imitation of biology). With these changes, are humans finding social structures like family or friendships in embodied and personal technology experiences? 3) *Time to Compile*. How long does it take to find resolution with or understanding of different technologies? How long before we iterate on the first design and find a second? Who gets to investigate the inner-workings of these machines before? When have we assimilated

a new technology permanently? How will we change?

The aim of *Time to Compile* is to reveal the hidden human network and to alter the objective action of the participants, testing the hypothesis that human plasticity can be exploited through technology. As the hidden human network is unmasked, participants recognize how this embodied illustration of the network can be reflected across the spectrum of their daily life. For example, self-driving cars are in fact machines created by humans and programmed by humans, with biases from the teams that made them. It follows simply from these machines are limited to their programmed capabilities. Self-driving cars cannot learn a choral ballad or create a floral arrangement. This realization of the hidden human network results in a reclaiming of human identity and a questioning of their own assumptions about robotics and technology.

III. LOOP DESIGN: ARTISTIC GOALS

The internet is no longer the separate, computational space it has been the past 4 decades; more devices are hooked to the internet than people and 50% percent of the global population is connected. Given this massive network, device and app makers have prioritized speed and ease of use over sincerity and humanism. As a result, human to human digital interactions are shallow, wide, and discrete in order to quicken and simplify engagement. Taps and likes are examples of this. Qualitative, abstract phenomena like adoration or love have been reduced to binary on the internet.

The average American spends more than 10 hours a day staring at a screen; thus, the governing principles of digital interactions logically permeate analog lives. Digital vocabulary words like “swipe” or “DM” enter live conversation. Patterns of digitally-focused movement, from holding a cell phone to typing on a laptop, affect the physical posturing and spatial awareness of individuals even while these tools are not present. How human interpersonal relationships change in light of these digital influences is less clear. One hypothesis we posed is that humans become less sensitive to live, bodily experiences and less likely to acknowledge other humans around them. A mechanism to address this in performance would be for all audience members to participate in a moving, improvisational group exercise.

A resulting artistic goal is to have all audience participants interact with an artificial agent that represented a human moving on the other end of it. This experience represents the hidden human network in an immediate, visceral form as well as engaging the human participant in a literal mirroring of robot motion, addressing the question of “are humans becoming more robot-like?” By asking the participants to rotate from exercise to exercise, participants are challenged with new activities that vary in personal compile times. This artistic experience echoes the transition of digital influences and reactions into everyday life, while using the performance context to elevate emotional considerations and educate the public about typically inaccessible robotic technology.

A second artistic goal is for *Time to Compile* to evolve based on audience contribution, similar to the collective, content upload format of the internet. The audiences illustrations,

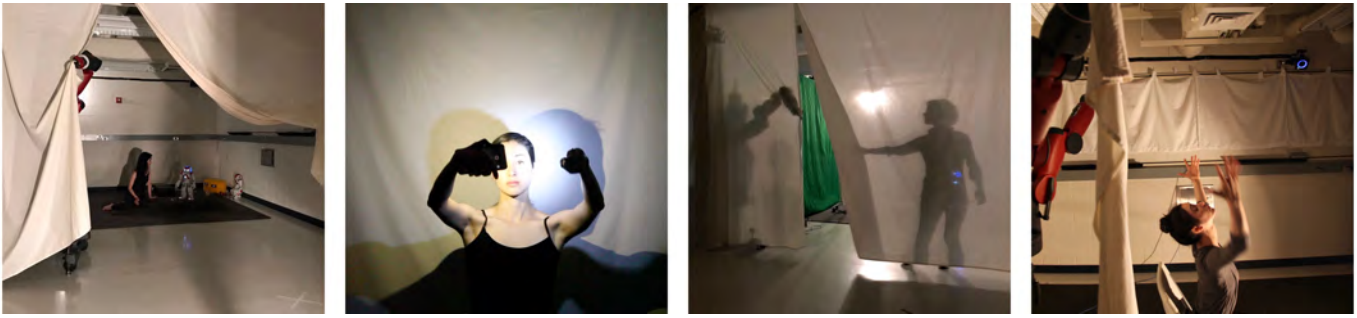


Fig. 1. Images from *Time to Compile* showings on June 30, 2017 and December 16, 2017. These moments are from the live performance that precedes the interactive loop described here.

pictures, and movement appear in the piece, therefore welcoming the public into the practice of performative art-making. After each informal showing in June and December, 2017, the audience provided feedback which has impacted each work session and the overall narrative of the piece. This feedback is critical in understanding how audience members, as a sample group of the population at large, view technology and how those feelings manifest within *Time to Compile*. In doing so, performance becomes a rapid prototyping opportunity to mold how individuals perceive new technologies. Additionally, giving the public the opportunity to experience this technology un.masks often intimidating machines. Through each showing, the *Time to Compile* collaborators will be able to further develop the sophistication of their initial material and bring the public into the rich space of overlap between robotics and choreography.

A visual artistic goal is to eliminate the boundary created by phones and computers between the digital world and the “real” world, therefore creating a live representation of the internet. The piece employs soft elements (both live and pre-recorded) like sheets, skin, and sex to contrast the hard lines of robots, virtual avatars, and transistors. *Time to Compile* takes the form of an embodied analog for the Internet of Things where performers (including dancers and engineers) help audience members make sense of this “place” and this “time”. The mood of the piece is distant and remote yet sparkly and intriguing.

Sonically, this piece aims for multi-genre music and abstract dialogue to amplify the visual environment. Both music and speaking should seem disjointed, frictional, and circuitous. The goal was to spark confusion about the geographical and temporal location of the performance. To convey this, Catie sought music with suspended melodies, digital influence, wide-ranging sampling (from drum sounds to birds chirping), and consistent moderato to allegretto tempos. In the most recently performed version of *Time to Compile*, the sound varies from speaking (both human and robot vocalizations), to music from artists like Midori Takada, Andrew Bird, and Four Tet.

IV. LOOP DESIGN: TECHNICAL IMPLEMENTATION

The Loop in its current form is performed in any large space with chairs (e.g. proscenium theaters as well as open rooms). This space is divided into 5 node labeled 0 to 4, separated

by opaque curtains, with participants moving through each node once. The nodes contain technological elements (robots and virtual reality) that participants are asked to interact with. There are several small flashlights and headlamps around the stage and on the robots. This setup is named the “technological system”, and it looks like the creative teams vision of what the inside of the internet is. There are two main parts to the Loop, one static, and one interactive.

For the first, static part of the performance, participants are asked to sit in Node 0. This section contains theatrical lights, a sound system, a projector and chairs that are lined up in front of a large scrim. The performance begins when participants are asked to sit on the chairs, following which a theatrical short film is projected onto scrim. Following this, audience members are invited to enter the technological system where they begin interacting with, “The Loop”. In this second, interactive part of the piece, participants move through Nodes 1 to 4 of The Loop one by one, with interactions oscillating between simple and frustrating, simulating the feeling of alienation and satisfaction we often experience with machine and computer interfaces. The overall tone is safe, exploratory, and suspended.

During the Loop, Nodes 1 to 4 each contain one participant, along with a piece of technology that the participant interacts with, termed the “actuator”, and a means of collecting movement information from the interactive experience, termed the “sensor”. Data is transferred between successive nodes that inform the overall structure of the loop, as is explained below.

In Node 1, the participant (Player 1) is asked to engage in a movement game with the Baxter Research Robot (the actuator), a 6’ 1” tall manufacturing robot with two gripper-style arms. The Baxter robot contains an internal PC that runs its proprietary SDK software. It is connected to a Linux Workstation that runs Ubuntu 14.04. This workstation runs Robot Operating System (ROS) version Indigo, a robotics middleware that allows us to send and receive commands to and from the robot using the Baxter Robots ROS Software Development Kit (SDK). The Baxter robot performs a movement sequence, and the participant is asked to recreate the sequence by mimicking the robots movements. We term this as the “mirror game”.

The participants movements are captured by the Microsoft Kinect V2 sensor, an IR camera array that allows us to track skeletal movement profiles. This sensor is connected to a Windows workstation. The information collected by the Kinect

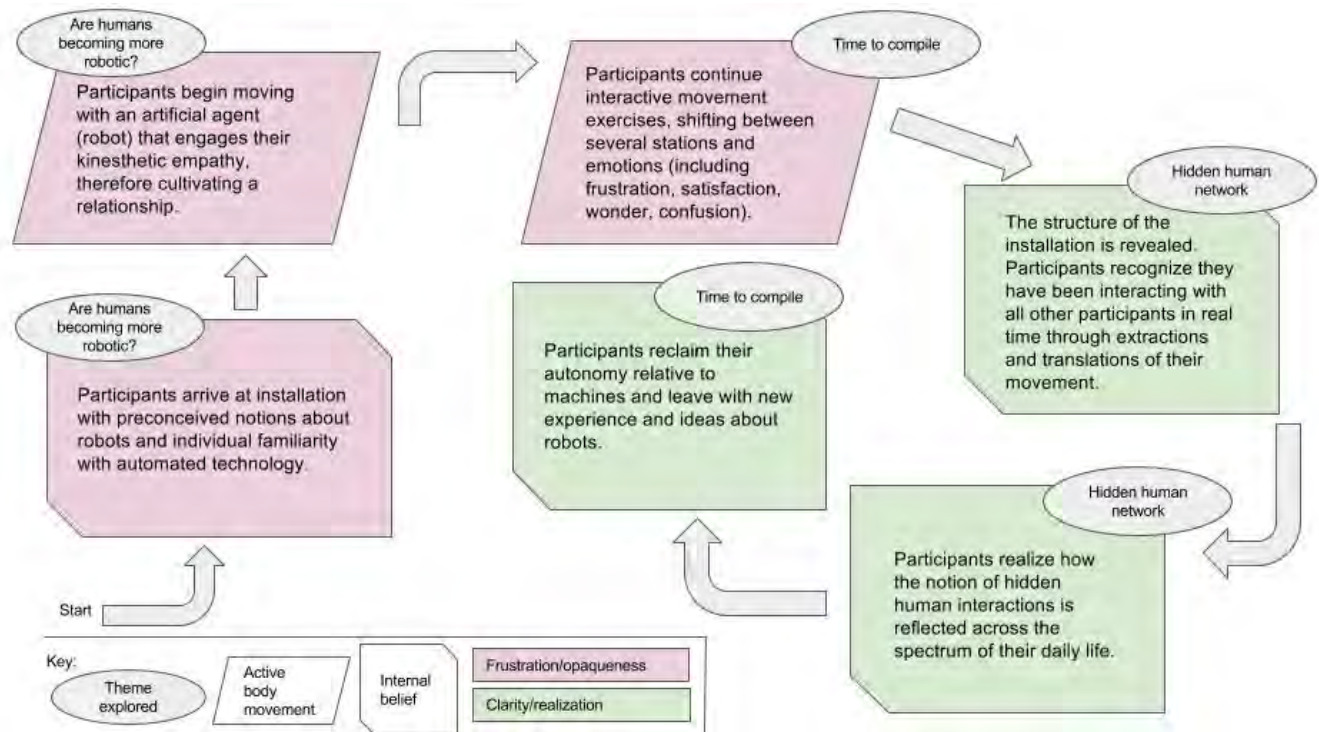


Fig. 2. High-level schematic of artistic goals for the interactive component (“The Loop”) of *Time to Compile*. The schematic shows a shift in obfuscation to clarity for participants and a change in internal beliefs about robots, exploring the three themes highlighted by the collaboration.

Sensor is processed by the windows workstation, and used in Node 2. In Node 2, the participant (Player 2) is asked to wear an HTC Vive, a Virtual Reality Headset that allows for room-scale immersion. This headset is connected to a windows workstation, running Unity 3D, a game development software for VR experiences. Once participants put the headset on, they are immersed in a large room modeled to look like a living room, where they see a virtual, humanoid avatar. This humanoid avatar receives skeleton tracking information from the Kinect V2 in Node 1, and thus follows the movements of Player 1. The participant is asked to play the mirror game with the virtual avatar. While the participant engages in the mirror game, another Kinect V1 sensor records their skeletal tracking information, that is in turn used in Node 3. This Kinect V1 sensor is connected to the Linux workstation.

In Node 3, the participant (Player 3) interacts with Nao, a small, 1' 11" humanoid robot. This robot is connected to the Linux workstation running ROS Indigo, using the Naoqi SDK. The Naoqi SDK contains software that allows us to control movements of the Nao robot using the Joint Control Application Program interface (API). We are currently working on a program that will allow us to move the Nao robot using the Microsoft Kinect V1. This will allow us to pull the skeleton tracking information from Node 2, and use it to control the movements of the nao robot in Node 3. Player 3 is asked to play the mirror game with the nao. Again, the players movements are recorded by a Kinect V1, with the skeleton tracking information sent to Node 1. The Baxter Robot in Node 1 is teleoperated using this skeleton tracking informa-

tion. An example of teleoperation of Nao and Baxter using the Microsoft Kinect is shown in /reddivari2014teleoperation and /almetwally2013real. This, there is a cyclic transfer of data from Nodes 1, 2, 3, and back to 1 as participants engage in the Loop.

At the center of the loop lies a 360° camera that live-streams 360° video of the loop in process to a YouTube stream. This camera is placed in a way such that it has a view of every section of the loop. In Node 4, participants are asked to wear a Google Cardboard Virtual Reality Headset with an enclosed smartphone. This allows users to view the YouTube livestream in virtual reality, thus revealing the mechanism of the loop. This section acts as the “grand reveal”, where participants are shown the cyclic nature of the loop and that their own movements drive each of the nodes.

Audience members often express that The Loop feels like a journey. The participants, while separated in space by about 10 feet, engage with the technology (the Baxter robot or HTC VIVE) in front of them. While immersed in their discrete exercises, they are under the guise that they are having a standalone experience with a machine. In actuality, they are moving with other humans whose extracted skeletons are being tracked onto all machines in the exhibit. Therefore, through the technological elements employed, the spatial, physical, and psychological borders of the installation are manipulated by the artists through exchange between each. This porousness allows for a malleable experience where participants float in a room we design to focus on interactions rather than demographic and personal characteristics; moreover, it is human

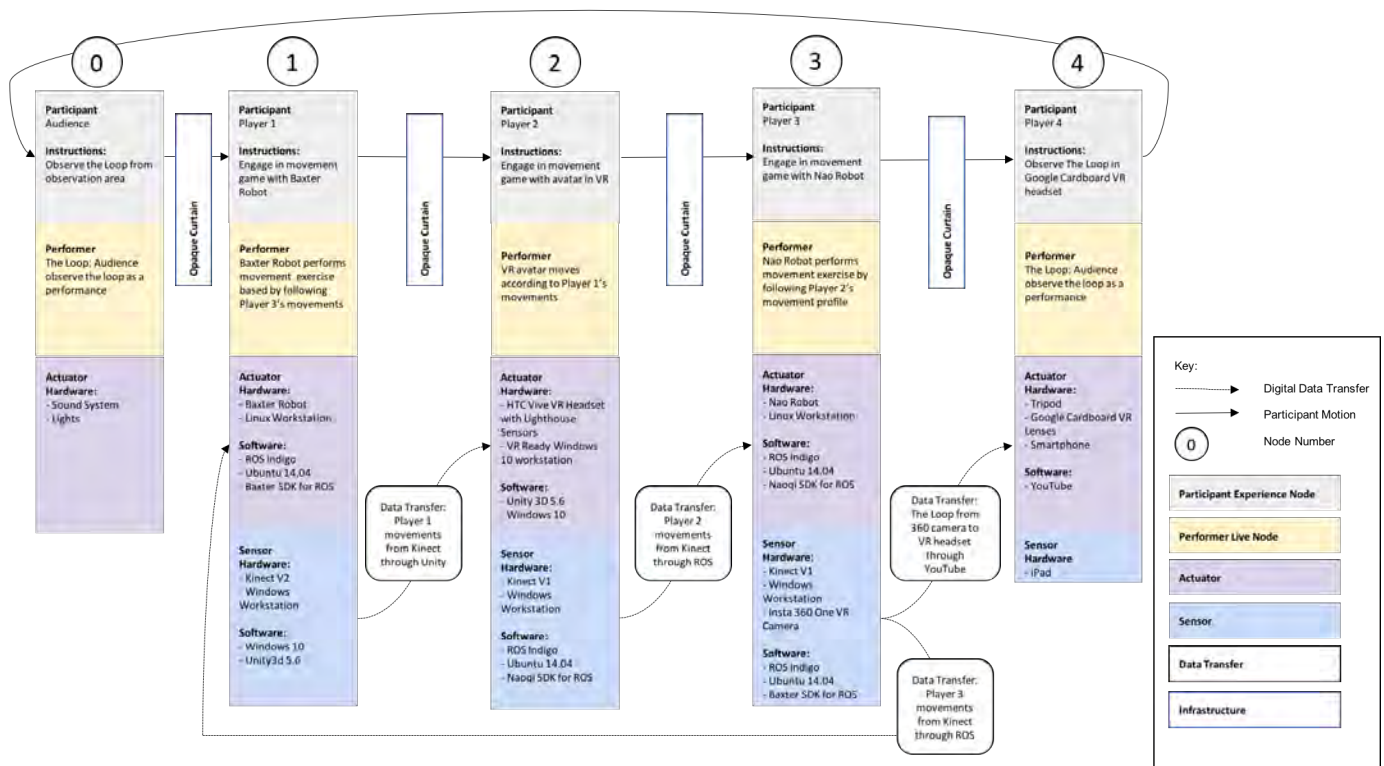


Fig. 3. Detailed schematic of the technical implementation of the interactive component (“The Loop”) of *Time to Compile*. The schematic shows the relationship between sensors, actuators (the hardware of “The Loop”), participants and performers (the human elements), and data transfer between elements (the digital component that could become an archival record of the piece).

behavior, that invisibly drives the exhibit, which is revealed to participants by the end of their experience, just as the internet is driven by obfuscated humans.

V. SURPRISING SYNERGIES AND PAIN POINTS BETWEEN ARTISTIC AND TECHNICAL GOALS

You dont know what you dont know, and at least initially, this involves quite a bit of me being in the dark. I mean this in a few ways: in terms of process: that Amy and I haven't worked together before and I've never been to UIUC (what will her students think?!); in terms of vision: I think we are both expecting to build a narrative out of dance and technology but arent sure what that means; and in terms of stakes: that risks and opportunities may present themselves or not.... I've also considered how the human has been left out of the mainstream discussion when it comes to robots. Theres a popular fatalistic economic argument about robots – that robots will cost manufacturing and driving jobs – but that is more about economic restructuring than it is about human beings.

The quote above was written in an internal blog post by Catie before arriving at the RAD Lab in June 2017. It offers a window into her perspective before joining a group for an extended period of time with an open-ended charge. It demonstrates both the excitement and anxiety that preceded our collaboration (on both sides).

This collaboration between artists and engineers has highlighted opportunities to share semantics and practices across disciplines, for the creation of new art, new robots, and new academic study formats. Several challenges, which pose unique opportunities for learning and inspiration, are embedded in this pursuit, including:

- Delineating a shared language, despite differences in choreographic technologies (e.g., repetition, retrograde) and mechanical engineering technologies (e.g., transistors, control systems).
- Establishing mutual support between all collaborators, especially as skills and experience differ and as institutions undervalue body-based work.
- Determining goals for this collaboration, including a mutually compelling performance piece, valuable robotics research, interdisciplinary curriculum, and personal fulfillment for both artists and technologists.
- Creating a performance than can be understood by an audience, despite common perceptions that automated machines are quantitative and perplexing.
- Understanding the relationship between humans and the technical tools that are inspired by them.

On the one hand, we had decode each others language and norms. On the other, once we'd come to internal understanding, we had to create something that can be understood by others who weren't around for the residency period. Both tasks were daunting... Catie needed to be supported as she interfaces with opaque technological tools, which tend to impress

outsiders just because they seem hard to use, regardless of whether they are actually interesting.

That natural human reaction to technology – that it is this murky monolith, inflexible and quantitative – creates a tension that is ripe for misunderstanding. The digital technology roboticists like Ishaan use to control robots only magnifies this reaction because the tiny transistors doing all the work are invisible to the naked eye (and also hidden behind plastic encasements). Moreover, our collaboration took place in an institution (the academy) that systematically undervalues body-based work, such as, the research performed during improvisation.

What has been fruitful about this collaboration is that through a combination of confident personalities and upfront acknowledgment of these challenges, the technology employed has been viewed as a creative medium accessible to all parties and, on the flipside, the experience and ideas of technologists has been integrated into the narrative of the artistic piece. This has allowed our choreographer to deepen her understanding of the mechanisms behind, for example, a humanoid robot. It's broadened the perspectives considered by the robotics students in the RAD Lab. Moreover, both sides have a better grasp on the complexity of humans in contrast to the simplicity of our technical tools that exist in our shadow. It's a flip in initial expectations that still honors the excitement that brought everyone to the table.

VI. CONCLUSIONS

This paper documents an ongoing collaboration between the RAD Lab and choreographer Catie Cuan. We have diagrammed – from two distinct perspectives – an interactive art installation that accompanies live performance in *Time to Compile*. Moreover, we have shared insight into the internal processes of our collaboration, in hopes that it may prepare and spark similar collaborations between others.

Our future directions include more (and more polished) showings, fleshing out custom algorithmic tools to support the artistic goals of the piece (including live tracking of human forms as in [10, 1]) furthering the cross-training (training outside ones own disciplines) of the members of this collaboration, and bringing audiences new perspectives on technology's role in daily human life, robotics, and the Internet of Things.

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Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

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Abstract

The Radium Girls: A Radically Advancing Tour of Exits Signs juxtaposes stories about technology used to produce exit signs with the story of the Radium Girls. The Radium Girls were female factory workers of the 1920s who were exposed to radium—using it to paint watch dials—and fell deadly ill. The workers fought (and lost) a long judicial battle over reparations, which did, however, help to establish new worker rights laws and radioactive materials safety laws. *The Radium Girls: A Radically Advancing Tour of Exit Signs* is presented as a self-guided tour of the exit signs in an exhibition space. It presents audio as captured voices in bird cages that hang in front of or near exit signs. The tour mixes facts about the production of the exit sign with historic details to unveil the fate of the Radium Girls.

Keywords

Labor, Worker Rights, Sound Art, Feminism, Participatory Installation

Introduction

The Radium Girls: A Radically Advancing Tour of Exit Signs engages the public by inviting them to explore an omnipresent and often overlooked piece of public architecture: the exit sign. The self-guided tour connects scientific information and information about legislation of the exit sign with the often unknown struggle of the Radium Girls. The tour reaches the public literally where they stand to raise questions about female labor, worker rights, and the social cost of technological advancements.

Most of the Radium Girls died of “Radium Jaw”, an occupational disease radium workers fell victim to because the body understands radium as calcium and substitutes one substance by the other on the bone tissue [1]. Bones become fragile and porous, which can cause necrosis and severe distortion of the mandible and maxilla. When the women first started working with radium, its toxicity was not yet known. When scientists realized the effects of radium on the human body, company managers would not go near it. In addition, they did not create safety protections for the workers, who worked as if the element was safe.

Since radium shines in the dark, the workers would have fun with it, painting their nails, teeth and clothing. When the Radium Girls started to get sick, it took them years to find a lawyer who would accept their case and sue the company. When they started the juridical procedures, the company’s executives would use their influence and resources to try to demoralize the women. Statements were published to attack the workers’ sexual behavior and moral, indicating that the workers were sick because they had STDs. The companies positioned themselves as charitable because they hired disabled women, who in turn were ungrateful by their attempts to seek justice. After the legal processes were in movement, the company would try to push the trials back, so that the women would be either dead or physically incapable of going to court. Some of the workers settled with the company to compensate for payment of their medical bills and never received the reparations they deserved.

The physical pain and horror of the Radium Girls and the repulsive behavior of the company that formerly employed the women opened discussions about safety in the radioactive workspace, creating standards that are still followed today. The piece not only honors those bodies and the social and political changes they provoked, but also rescues a story about workers on technology industries that still happen in different versions today. When operating or utilizing technological infrastructure ubiquitous in contemporary society, we often do not think about the human labor involved in the production of such invisible signals and connections. While some of us live in updated conditions for our safety and health, many people work in conditions that would be familiar to the experience of the Radium Girls.

The Radium Girls: A Radically Advancing Tour of Exit Signs creates a space within everyday places for the public to hear stories of people who were voiceless when they were alive. We instigate participants to connect the past to the present, understanding relationships and legacies of class, production, and socio-technological standards.

A History of *The Radium Girls*: A Radically Advancing Tour of the Exit Signs

This work has undergone several iterations since its first inception in November 2016 when it debuted as a face-to-face tour, which we led at The Dallas Museum of Art during a DADA-inspired “Late Night Art Bytes” event (Fig. 1).

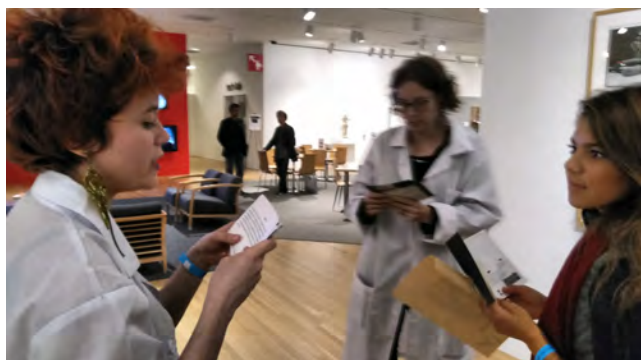


Figure 1: *The Radium Girls: A Radically Advancing Tour of the Exit Signs* at the Dallas Museum of Art, presented as a face-to-face tour in November, 2016.

The portion of the title, “A Radically Advancing Tour” is derived from *The Little Review*, a quarterly publication started by two DADAist women in New York City from the 19-teens to the late 20s [2]. We imagine the exit signs on our tour demonstrate the Review’s idea of an “advancing point” toward which the “advance guards” are always advancing. Since we developed the project for this DADA-related event (Fig. 2), the story is told in fragments with an absurdist turn, “a tour of the exit signs” as the conceptual container for the project.



Figure 2: Flyer for the “Big Dada” exhibit planned by Lab-SynthE at The Dallas Museum of Art, where the *Radium Girls: A Radically Advancing Tour of the Exit Signs* was first presented.

In January 2017 Frank Dufour was the sound engineer who recorded and edited our tour script as an audio submission to The HearSay Audio Festival. We were finalists in the international competition. We decided to reuse the audio, cut into five segments, in the next iteration of the piece.

In March 2017 we exhibited this project as a sound installation using directional speakers in a hallway that had four exit signs visible from a central location (Fig. 3). As participants walked beneath each exit sign she would hear that portion of the story.



Figure 3: *The Radium Girls: A Radically Advancing Tour of the Exit Signs* as a sound installation using directional speakers aimed at nearby exit signs. Feirra, burrough, and Dufour (members of LabSynthE), The School of Arts, Technology, and Emerging Communication at The University of Texas at Dallas, March 2017.

In May 2017, we exhibited the piece with birdcages and Raspberry Pis, but the audio played on a loop and we used speakers in lieu of pull-cords. This enabled us to install the cages from the ceiling, near the exit signs (Fig. 4). However, the audio looped and created noise throughout the duration of the exhibition.



Figure 4: The birdcage acts as a physical metaphor that traps the audio of voices telling a story that centers on worker's rights.

This fall we teamed up with The Gizmology Lab at The University of Texas at Dallas, led by Dale MacDonald, who also supervised Darrell Keller, to code the Raspberry Pis so they would be triggered by pull-cords on each cage. The project was first exhibited in this iteration at HASTAC in Orlando, November 2017 (Fig. 5).



Figure 5: *The Radium Girls: A Radically Advancing Tour of the Exit Signs* at HASTAC, Orlando, November 2-4, 2017.

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Authors Biographies

Leticia Ferreira and xtine burrough collaborate in an ongoing project that tells the story of the Radium Girls by blurring fact and fiction on group tours, in technology-enhanced installations, and in sound objects. Ferreira is a PhD student and research assistant for the Public Interactives Research Lab (PIRL) at the School of Arts, Technology, and Emerging Communication at The University of Texas at Dallas. She is a creative practitioner with LabSynthE, a laboratory for the study of synthetic and electronic poetry and creative investigation in ATEC organized by professors burrough and Dufour.

xtine burrough makes participatory projects for networked publics using digital media to translate common experiences into personal arenas for discovery. burrough is co-editor of *The Routledge Companion to Remix Studies* (2015), author of *Foundations of Digital Art and Design* (2013), and editor of *Net Works: Case Studies in Web Art and Design* (2011). She is Editor of the *Visual Communication Quarterly*. An associate professor in the School of Arts, Technology, and Emerging Communication at The University of Texas at Dallas, burrough co-directs Social Practice & Community Engagement (SP&CE) MediaLab and

Video Documentation Online

This project is best understood in person, as a participant/viewer. The next best way to see the project in action is through video documentation, available on Vimeo: www.vimeo.com/xtineburrough/radiumgirls

LabSynthE, a laboratory for the investigation of synthetic and electronic poetry.

Leticia Ferreira is a PhD candidate at the School of Arts, Technology and Emerging Communication at the University of Texas at Dallas. She is a research assistant at the Public Interactives Research Lab and a member of the Laboratory for Synthetic and Electronic Poetry (LabSynthE). Her interests include intersections of culture and technology, especially interactive media in public spaces and its cultural, political and aesthetic impacts. With LabSynthE, Leticia performed at the Dallas Museum of Art in November 2016, and participated in “The Neighbor’s Weed” at CentralTrak, in May 2017. The pieces *Radium Girls: A Radically Advancing Tour of the Exit Signs* (in collaboration with xtine burrough) and *Streaming of the Past* (in collaboration with Murilo Homs) were presented at HASTAC in November 2017.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Acoustic Territories: a sonic and ethnographic study of Sunset Park, Brooklyn.

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Abstract

The paper focuses on navigating the soundscapes of ethnic enclaves in the urban environments of Sunset Park in Brooklyn. Is it possible to get a sense of the cultural immersion through sound? What does the local soundscape tell us about the growth or destruction of native enclaves? How does the existing soundscape shape the process of adaptation? How do the sounds frame the public perception of the environment and the sound walker identity?

This investigation is constituted by a sonic analysis of the acoustic territories built by the cultural spatial codes embedded in soundscapes of Sunset Park in Brooklyn, with more heterogeneous enclaves, sharing the space with the Mexican, Chinese, Middle East and Puerto Rican immigrants.

Keywords

Soundwalk, Film Essay, Immigration, Identity, Sound Ecology, Dérive.

Introduction

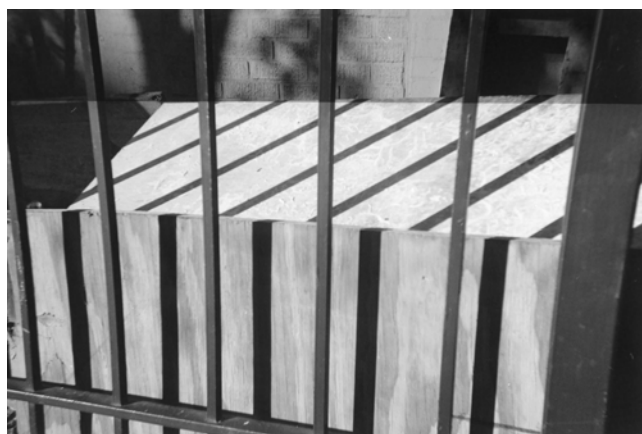
My relationship with the urban environment of a city has been developed from my experience as an immigrant. I began to understand the geography of Chicago through my personal journeys from the north side to south side. I discovered that each pole had a specific ethnic group, a population delimited by a number of blocks, languages, cultural codes, which constituted a fragile interaction between neighborhoods. After a year inhabiting the city, I was focus on the process of adaptation to the American culture by visiting the Mexican neighborhood. My Ameri-

can friends pointed me to Pilsen, build by Bohemians in 1851 and currently known as the Mexican neighborhood. The neighborhood opened my eyes, my ears, and somehow cured my nostalgia for Mexico. Hearing my mother tongue, with an accent of the northern side of Mexico was not entirely similar, but closer to my idea of my home. I was fitting into space, place-making my own niche in an architectural European-Mexican palimpsest. I lived for almost fourteen years in Pilsen, during which I produced several experimental documentaries dedicated to its multiple generations of immigrants that constructed it. In my sound and walk explorations, I made several workshops with residents who shared their own historical relationship with the neighborhood.

In the fall of 2016, I moved to NYC, looking for a similar experience of cultural adaptation through the familiarity of the Mexican settlement. I found that the Mexican diaspora is relatively recent in New York City. In the Midwest the first settlements record by the Hull House in Chicago, back to 1920 due to the railroad construction affiliated to the Bracero program between U.S and Mexico. [1] Therefore, in Brooklyn the adaptation of the Mexican enclave still is a new process. Nevertheless, I observed that still is less segregated and far more integrated than Chicago to other immigrant groups such as the Chinese, Puerto Rican, Dominican and the Middle Eastern. That is the case of Sunset Park, a neighborhood in south Brooklyn where the intersection among cultures can be experienced in the commercial street of 5th Avenue through the 37th and 60th Street.

The influence and origins, from the *dérive* to rhythmanalysis.

The soundscape is constantly changing and that gives us the ability to understand social relationships given in the urban fabric. The Situationists have explored this approach as an avant-garde group that detonated crucial political, philosophical, and aesthetic questions in the 60s, building upon a Marxist perspective. Their reflections made critical questions about everyday life in a city, through daily walks, using the drift (*dérive*) as an analytical tool that questions the relationship between the individual and their space. In this regard, my artistic and theoretical practice thrives on the collective experience of walking as a critical and self-reflective tool to observe the architecture affection to the individual.



Protecting from the sun, 2015. B/W 35mm print.
Amanda Gutiérrez

As an example of the incursion between pedagogy and social practices, I developed the collective project *Pilsen Dérive*. It started in 2014 as part of the artist residency at *The Maker Space*, awarded by the University of Illinois at Chicago, within the premises of *Mana Studios* in the Pilsen neighborhood. *Pilsen Dérive* was a practical and theoretical workshop, open to the general public interested in the history of Pilsen and the current gentrification of the neighborhood. The workshop made a series of weekly workshops based on the history and theory of Situationism and implementing psychogeography practices such as creative cartography, drawings, and collective walks. Through thematic drifts these workshops focused on visual auditory practices, and in some cases photographic approaches, which opened spaces to discussions around the concept and accessibility to public space. These observations allowed each participant to create an individual project exposed in a group exhibition made from the workshop. The workshop

opened lines of discussion about urban planning, such as zoning disputes and violence between local gangs, buildings that divide the public space, the location of green spaces such as parks and gardens, buildings and industrial infrastructure as sources of contamination. My teaching method in the development of this workshop originated from my experience with the *Nerivela* art collective in Mexico City. The collective is based on contemporary art practices through group relationships between the individuals involved, which have different interests and social approaches. In this way and through interdisciplinary practices *Nerivela* explores a diversity of subjectivities and openness for the participation of groups invited to procedural site-specific events in Mexico City. *Nerivela* takes into account the context and social interaction with individuals belonging to a specific neighborhood, creating experiential and aesthetic situations in and with the collective. This is the case with their piece *Residuografía*, exposed in the National Museum of Geology, where they analyzed strategically through collective walks the waste of the neighborhood as an indicator of the relationship between the inhabitants and its own context.

This experiential reflection of the spatial architecture and its relationship in an urban environment is included in the studies of the sociologist Henri Lefebvre, who focused on the analysis of the space and everyday life. In his last publication entitled *Rhythmanalysis*, Lefebvre approaches the bodily measurements of sensation with the sound of the city, finding and listening the sound frequencies through cycles of time, and activations spaces based on cyclical temporalities present in standard measures such as hours, days, months, and years. Each space changes or activates day by day and it has different uses in different temporalities. This interaction of space and time can be seen in work routines that activate a place with the flow of traffic on public transport, car roads, or subways, for example. This activation is mainly given by labor demands that are the engine of production in a capitalist society. For Lefebvre, the analysis of the bodily experience has three elements: speed, frequency, and consistency, which can be experienced simultaneously or in isolation. These measures are given in our heartbeat; breathing and organic routines inserted in our work routine, such as relaxation, stress, anxiety, which are activated during our urban navigation. The sensory analysis of these conditions can be exercised by frequency measurements, which are present in our everyday life. Lefebvre proposes a technique for observing these stimuli, taking into consideration the sensorial and physical interactions with the body as another object in the space. Lefebvre points out that the concept of "presence", which underlines the cultural and natural relationship that makes these interactions sensitive readings of a location, based on the subjectivity of the individual who experiences these various rhythmic forms. Lefebvre establishes an intimate relationship with the musical construction and bodily per-

ception, using four rhythmic tools: arrhythmia, polyrhythmia, eurhythmia, isorhythmia. These tools can be applied in the study of our relationship with the environment in which we may be bombarded with media stimuli as an ideological noise that leads to constant consumerism. [2]

These spatial reflections are also mentioned in the book *Society of the Spectacle*, in which Guy Debord describes the urban design as a tool of capitalism to exercise control over production, isolation, and thus control its inhabitants' physical and economic mobility. Debord suggests the practice of a drift, walk, and wondering as an act of rebellion against productivity that capitalist society demands from us. In the manifesto, *Theory of the Drift*, he suggests strategies such as psychogeography as an analytical tool to identify the emotional and psychological relationships experienced, while being bombarded by media environments in an oppressive architecture. If we are aware of the effects a space has on our emotional and intellectual perception, we can generate a critical attitude to what goes unnoticed in urban design. [3] Is in this unnoticed environment, where many of our affections and behaviors project. The space of the infra-ordinary that Georges Perec describes in his book *Species of Spaces*, in which he considers the multiple connections between private space and public, from the micro to the macro. His narrative suggests subtle observations of the social implicit in the ordinary places inhabited in the room, the neighborhood, the city, a continent, and the world dynamics. [4]

As part of my sound walks, I emphasize these relationships we take for granted before questioning the invisible borders, ethnic prejudice, and geographical and ideological divisions that an urban plan emphasizes. These divisions are given as part of segregation and geographic segmentation in a city, which are elements that we take for granted and normalize as part of the everyday landscape. In this case how segregation plays an important role to divide minority groups that are systematically marginalized.



Paradise Memories. 2017. Color 35mm print.
Amanda Gutiérrez

The subjectivity and critical decisions of the recordings

My current research aims to understand the intercultural relations in the processes of urban settlement of Mexican immigrants in two cities, Chicago and Brooklyn. The subjective relationship with my own experience as an immigrant artist also speaks of my own process to live, adapt, and explore the city from sensorial observations, specifically through sound and images. For me the essential questions how are listening and gathering information, what was the main criterion for the selection of locations, times during the day, conversations, facades? And what kind of spatial relationship establishes the cultural identity of the observer, the ethnographer, and the artist with the subject? How these social relations are affected or influenced by the sound field recordings and photographs?



The Iron Lady. 2017. Color 35mm print.
Amanda Gutiérrez

These questions are present in various mediums used in the documentation of my walks in these neighborhoods. In my theoretical and artistic research I understand the relationship between the environment, the documentation, and my role as the editor. The sound contains subtle content and relevant information about the context as well as the cognitive experience of the listener. The study of sound has been extended to other disciplines in the social sciences such as acoustic ecology, which has transcended into other field of studies such as ethnomusicology and anthropology. Some approaches in the study of sound in space raise questions about the interactions between the documentary filmmaker, researcher, and participants as an essential part of their conclusions.

In the academic practices of acoustic ecology, I have observed a critical lack of the recognition of power dynamics inherent in field studies. These questions can open a reflection about the cultural and political implications of studying, analyzing, and codifying the spatial sound recording into an aesthetic or academic subject. During the recording of my own soundwalks it is important for me to understand my own identity and cultural relationship with the location. This brings me a moment to reflect on my intentions and interpretations, through familiarity or disconnection. It is also essential to know the group to whom I will develop this process, first individually and then collectively. In social practice projects, the interactions in the public space leading a soundwalk can take different positionalities, like a bystander or a performer, as an agitator, as a tour guide. In these multiple situations, I try to raise questions about gender identity, social class and ethnicity that will provide information to the sound recordings.

The scholar Dylan Robinson in his research regarding the indigenous cultures of the First Nation and Inuit in Canada deals with these policies describing the listener or documentarian foreign sound as a *guest listener*. Robinson defines the *ethics of listening* to the critical relationships existing in the exercise of recording, interpretation, and dissemination of sound cultural codes, whether given by language, singing, sacred melody, popular, or a soundscape catching a particular environment. In this listening exercise, Robinson suggests a self-reflexive activity through ethical strategies, which do not involve exploitative practices of a colonialist regime, cultural exotification, or intellectual fetishization. He calls these practices that feed the cultural otherness and academic voyeurism as *hungry listening*. On the other hand, these self-reflection strategies of listening try to avoid colonialist values of knowledge existing in archaic anthropological practices. Robinson suggests that this ethical listener can start by understanding that there are cultural codes to which we have access, as well as by the awareness of the power relationship that can exist between the subjects who interprets this information with academic or institutional purposes. [5]

In the case of the soundscape understood as an environment, there are political decisions and declarations when the documentarian decided to record a time, a place, and an event that defines a community. *The Ultra-red* collective published in 2008 the manifesto entitled *10 Preliminary Theses on Militant Sound Investigation* to emphasize the critical situation of the sound archivist as an activist. In their first thesis they define the term as:

“Militant Sound Investigation, simply put, derives from a practice of listening that intervenes upon the presumed fidelity of the audio recording. Analysis of the registers of need, demand, desire begins with an initial cut in the record” [6]

The analysis of sound recordings arises from the demand and desire for an object, it begins with an initial cut and

ends with a recording, therefore a document is saved and forms a file as an archive. *Ultra-red* defines as the pedagogy of hearing to the use of recording technologies as an analytical and critical listening. The Militant Sound Investigation captures and edits by collective decisions with an activist target, i.e. understanding sound as a political tool. The collective entity has an important role in each of the 10 theses, understanding the collaborative relationship from the decisions of recording (point the microphone to a situation), how we record the situation (also through writing, quoting, memory), understand the silences (when we pause the recording), and discuss the sound editing as a critical act.

These two arguments influenced the critical production of my own recordings, not only sonically speaking but also in visual terms. The materials, the tools, the invasiveness, the editing process, and its materiality, speak volumes about the identity politics that are rendered in the mediated processes. There is no neutrality in a recording.



Simulacrum 1. 2017. Color 35mm print.
Amanda Gutiérrez

Adapting the sounds and images

The use of the walk as an instrument allows me to embody the space while being aware of my own cultural identity and gender, a subjectivity that can be translated into my own binaural sound recordings and 35mm photographs. The script of my film essay “Walking on Lightness”, reflects of my role as woman of color decoding, accessing, rejected, embraced in the public space of an immigrant neighborhood that is predominantly Mexican.

In Sunset Park the segregation can be perceived along with the threatening signs of gentrification, approaching it day by day from the riverside. The sound recordings are a subtle observation of my own cultural identity by the interactions that I remember on my walk, and notate on the photos, making it visible when I capture images of the store-

fronts. The current production of my film essay “Walking on Lightness”, incorporates cut-out animations utilizing these images of 35 mm photo prints, as well as video of the darkroom used on their printing processes. It serves as a metaphor of my self-taught cultural assimilation into the American Culture. The film essay incorporates animation techniques as the abstract interpretation of the sensorial memories. These photographs were taken with disposable 35 mm cameras, because of their invisibility and its non-credibility as a reliable medium for documentation. My images carry the absence of individuals, only capturing the trace of human production, visual accidents, flickering effects. The photographs can show some personal interest, the posters of some ranchero Mexican groups that I will never listen to, murals of salsa musician heroes from Puerto Rico.



Simulacrum 3. 2017. B/W 35mm print.
Amanda Gutiérrez

The sound recordings contain the crank of the camera passing the analog film as an indication of the shot, some conversations with street vendors, revealing accents, negotia-

tions, quick anecdotes, the easy connectivity with the Spanish language and its cultural codes. The binaural tracks reveal my own desire of finding something amusing, my own fears of inaccessible places, and the phase of my walking rhythm.



Simulacrum 2. 2017. Color 35mm print.
Amanda Gutiérrez

The production of the film essay "Walking on Lightness" has the goal of adapting these still images and sound recording, into the cinematic subjectivity of a female body in the public space, specifically in a segregated neighborhood in New York. The limited access to a private space will lead to multiple chapters in the essay narrative. The video segments will be using the darkroom as the only indoor space where I need to find the perfect light balance and focus for the visibility, invisibility, blurriness or sharpness of the images, as a translation of my adaptation to become an American citizen.

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Author Biography

Amanda Gutiérrez explores the experience of home, belonging, and cultural identity by bringing into focus details of everyday practices whose ordinary status makes it particularly hard for us to notice their key role in defining who we are. Trained and graduated initially as a stage designer from The National School of Theater, Gutiérrez uses a range of media such as sound art and performance art to investigate how these conditions of everyday life set the stage for our experiences and in doing so shape our individual and collective identities. Approaching these questions from immigrants' perspectives continues to be of special interest to Gutiérrez, who completed her MFA in Media and Performance Studies at the School of the Art Institute of Chicago. Accordingly, these techniques also constitute the core of the pedagogical prac-

tice Gutiérrez has developed over a decade of teaching in academic institutions such as the SAIC, Connecticut College, and Columbia University. Gutiérrez has held numerous art residencies in FACT Liverpool in the UK, ZKM in Germany, TAV in Taiwan, Bolit Art Center in Spain, and her work has been exhibited internationally in venues such as The Liverpool Biennale in 2012, The Windor Gallery in Madrid, Spain, Kiasma Gallery in Paris, Action Art Actuel Gallery in Montreal, and Oltre Dimori in Bologna, Laboratorio Arte Alameda Museum in México City, among others. A recipient of a grant from the National System of Art Creators, in Mexico, Gutiérrez is currently a resident at the New York Camera Club, producing her most recent photo work at ICP and preparing a solo exhibition for Baxter Gallery, in Manhattan.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Why Should Our Bodies End at the Skin?

Enacting Cyborg Performance

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Abstract

In “A Cyborg Manifesto,” Donna Haraway describes how by the late twentieth century, humans have become hybridized with machines. While many criticize technology’s encroachment on human lives, Haraway suggests accepting a kinship between organism and machine. The result is the cyborg, a hybrid body that fluidly transcends mechanical and organic boundaries. *Why Should Our Bodies End at the Skin?* for sensor-equipped belly dancer, robotic percussion, and live sound processing, explores these ideas of intersectionality and fluidity between organism and machine by connecting human action and mechanical tasks. This paper describes the creative framework and associated technologies involved in the development of this piece.

Keywords

Interactive performance, sensors, robotics, dance, electroacoustic music.

Introduction

In her essay “A Cyborg Manifesto,” Donna Haraway explores implications of the increasing hybridization of humans and machines. Summarizing this position, Haraway states, “Late twentieth-century machines have made thoroughly ambiguous the difference between natural and artificial, mind and body, self-developing and externally designed, and many other distinctions that used to apply to organisms and machines” [1]. While society has been concerned with the ever-growing ubiquity of technology in human activity, most recently the development of artificial intelligence and robotics [2], Haraway challenges the negative outcomes of this sentiment, instead suggesting a kinship between organism and machine. In a broad sense, intersections

between human and machine suggest hybrid bodies, raising questions about embodiment in our contemporary technoculture where the lines between organism and machine become indistinguishable. Are kinship and unity the goal of this intersection? Do we fear the technological singularity, or have we already embraced it? As Haraway asks, “Why should our bodies end at the skin?” [3].

Why Should Our Bodies End at the Skin? for sensor-equipped belly dancer, robotic percussion, and live sound processing, explores these questions of intersectionality and fluidity between organism and machine. The performance enacts Haraway’s idea of a “cyborg world” consisting of “lived social and bodily realities in which people are not afraid of their joint kinship between animals and machines” [4]. *Why Should Our Bodies End at the Skin?* realizes the capability of the cyborg, or hybrid body, in performance, sonically connecting mechanized human movement and humanized robotic action.

Background

Both sensor technologies and robotics enable humans to interact with computer-controlled mechanical systems. Sensor technologies connect human action and machine tasks. Robots are often designed to complete human tasks; their motions reflect a mechanical abstraction of human movement. *Why Should Our Bodies End at the Skin?* integrates the Remote electroAcoustic Kinesthetic Sensing (RAKS) system, a wireless sensor interface designed specifically for belly dance movement, and the Configurable Automatic Drumming Instrument (CADI), a modular robotic percussion battery designed to be mounted on microphone stands and positioned to hit any object.

The development of *Why Should Our Bodies End at the Skin?*, as well as the RAKS system and CADI, is informed by gesture studies, and specifically the authors' concept of "choreographed sound" [5], which foregrounds embodied experience in the creative process. In pieces using sensor-based interfaces, the designer directly defines and maps the relationship between movement and sound, employing physical gesture as a composable parameter. By focusing on the mechanics of movement and its relationship to sound, choreographing sound engages an embodied perspective that involves tactile, kinetic, and kinesthetic sensory experience.

Performance Systems

Remote electroAcoustic Kinesthetic Sensing (RAKS) system

The Remote electroacoustic Kinesthetic Sensing (RAKS) system is an Arduino-based wireless sensor interface designed specifically for belly dance movement by Aurie Hsu and Steven Kemper (Figure 1). "RAKS" is a play on the Arabic term, *Raqs Sharqi* (Middle Eastern dance). The interface consists of a corset and a lightweight belt. The RAKS system is built with the LilyPad Arduino and communicates wirelessly with the software Max over a point to point network of XBee radios. The system is modular, and different sensors can be incorporated for different performances. The sensors used in *Why Should Our Bodies End at the Skin?* include a flex sensor in the corset and an accelerometer on the belt. The system also includes two programmable LED rings that are activated wirelessly from the computer and respond to the dancer's movements.



Figure 1. Remote electroAcoustic Kinesthetic Sensing (RAKS) system.

Configurable Automatic Drumming Instrument (CADI)

The Configurable Automatic Drumming Instrument (CADI) is a solenoid-driven, robotic percussion battery (Figure 2). The 3D printed striking arms are designed to hold a variety of beaters and are mounted on microphone stands to enable them to be easily positioned to hit a variety of different instruments. CADI is controlled via MIDI, and velocity messages control the solenoids' on-times, affecting the striking

force and allowing for dynamic control. CADI was originally designed by Steven Kemper, Troy Rogers, and Scott Barton of Expressive Machines Musical Instruments, with the iteration used in *Why Should Our Bodies End at the Skin?* designed by Kemper at Rutgers University.



Figure 2. Configurable Automatic Drumming Instrument (CADI).

Performance

The performance of *Why Should Our Bodies End at the Skin?* features a dancer equipped with the RAKS system, CADI and sound excitors actuating both drums and shaken percussion, and electroacoustic textures created from processed mechanical sounds. To blur the boundaries between organism and machine, the percussion instruments encircle the dancer, serving as a visual and sonic extension of her body. The choreography reflects the mechanical nature of robotic movement using isolations and body locks, while CADI produces a visual and sonic echo of this movement through rhythmic and sustained textures.

The RAKS system is used to translate the dancer's movement into sonic control in a variety of ways, including triggering CADI's attacks and varying the dynamics, panning sound events within the semicircular field of the setup, and processing the electroacoustic texture. A feedback loop emerges between the dancer's movements and CADI's mechanical actions, calling into question whether the human is controlling the machine or the machine is controlling the human.

The piece consists of three overarching motivic ideas. The beginning of the piece builds through a series of accumulating textural layers. Contrasting rhythmic sections reference the drum solo, a Middle Eastern musical form consisting of a fast-tempo virtuosic improvisation where the lines between leader and follower are indistinguishable. A

final section explores a “broken-machine” aesthetic. Characteristics of this aesthetic include mechanical repetition punctuated by “stuck” loops, noisy timbres, and the illusion that the robotic arms are malfunctioning.

Reflections

Performance systems based on sensors and robotics enable a human performer to step into the role of cyborg—merging their gestures with the actions of a machine. By exploring the performative possibilities of this type of system, we have attempted to recontextualize the negative implications of a hybrid body. In this sense, we actualize Haraway’s notion of a kinship between organism and machine, exploring a world where the cyborg does not represent an inevitable march towards the technological singularity, but rather an evolving, creative body.

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Authors Biographies

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Aurie Hsu is a composer, pianist, and dancer. She performs with the Remote electroAcoustic Kinesthetic Sensing (RAKS) system, a wireless sensor interface developed with composer Steven Kemper. Aurie has presented at NIME, ICMC, MOCO, SEAMUS, SIGCHI, Pixelations, Third Practice Festival, the Logos Foundation, *Cite Internationale des Arts*, and the *TivoliVredenburg*. She has received awards from the Ammerman Center for Arts and Technology and the International Computer Music Association. Aurie received a Ph.D. in Composition and Computer Technologies from the University of Virginia and holds degrees from Mills College and Oberlin Conservatory. Aurie is Assistant Professor of Computer Music and Digital Arts in the Technology in Music and Related Arts (TIMARA) department at the Oberlin Conservatory.

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Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Biomateria: Biotextile Craft

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Abstract

The intelligence of the body and the senses, particularly the sense of touch, speaks not only on an immediate digital level in terms of ‘hand’ and technology, but on a subtler cellular level as well. In researching and conceptualizing the haptic activity of mammalian cell cultures *in vitro*, I have come to understand, imagine and experiment with artistic translations of that communication.

This paper will highlight four years of biotextile tissue engineering research and artistic production, conducted during laboratory-based artist residencies, including at SymbioticA (University of Western Australia), Pelling Lab (University of Ottawa), Sacher Lab and Speculative Life BioLab (Concordia University).

This work, situated within frameworks of feminist performative and research-based practice, analyzes the “craft” of tissue engineering as a form of haptic epistemology—an embodied enactment/mimicry/redesign through creative and scientific means of the inherent haptic intelligences of the body and its systems of growth, regeneration and repair.

This paper will discuss the resultant artwork(s) that seek to generate an artistic and aesthetic knowledge base, stemming from and centred on the shared labour of physical laboratory experiments with semi-living mammalian cells. These microorganisms are understood to apply their own agency to the co-construction of textile-based, ephemerally inhabited cultural artifacts.

Keywords

Biotextiles, DIY bio, Biotechnology, Tissue engineering, Craft

Introduction: A Troubled Matter



Figure 1. Still image from surveillance footage (*Field Investigation*, 2015): This work includes live feed monitoring and video monitor display of *The Ossificatorium*, a certified Biosafety Level II laboratory established in the Black Box of the FOFA Gallery at Concordia University, Montreal. Here, visitors are shown donning lab coats and goggles as the artist performs the *Aesthetics of Care*, a demonstration of the labour of tissue culture maintenance.

ON NOVEMBER 5, 2015, Montreal newspaper, *Le Devoir*, published an article entitled, “Machines and Men”. In this article on human physical relationships with art and technology, they reviewed my exhibition, *Biomateria*, then current at the FOFA Gallery in Montreal. The author stated that visitors were invited to put on gloves and handle what could very well be human remains or human waste. [1] The materials in question were cultured mammalian cell

lines, both human and animal, which had been obtained from one of the laboratories where I worked. The exhibition included numerous tissue engineering experiments, with what I had successfully technically developed through *wet-weaving*¹, cultivating mammalian tissue growth on handwoven textile scaffolds *in vitro*.

These hybrid forms, or more generally, bodies, speculated to contain human remains, were, through the choice of media phrasing, spectacularized as abject objects. For me, this called into question not only our notions of what is categorically “human” in different contexts where bodies are presented, but also our negotiation of live or once-living material, particularly in art contexts.

These same materials are not treated as quite so abject, or quite so *human* within regular laboratory contexts, but more so as standardized research materials *of human origin*. Cell lines are alphanumerically categorized in a non-referential way so as to depersonalize, and thus, not empathize with the original person whose body was biopsied to obtain them. Biopsied materials legally no longer belong to the person they came from—they instead become non-autonomous material objects, kept live or not.²

Neither quite so disenfranchised nor quite so spectacular, I refer to the live microorganisms used in my work as *vital materials* and I mention vitality not only in terms of liveliness, but also in alignment with Jane Bennett’s definition: “the capacity of things... not only to impede or block the will and designs of humans but also to act as quasi agents or forces with trajectories, propensities, or tendencies of their own.” [2]

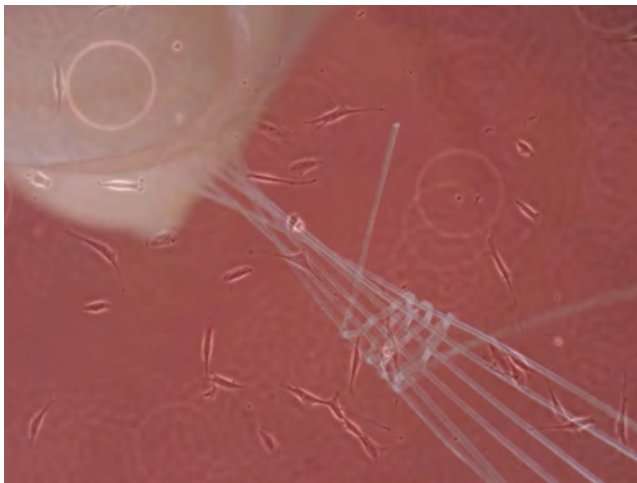


Figure 2. 24-hour time-lapse animation of mammalian cells overlaid with sample of handwoven horsehair textile scaffolding.

¹ My invented term for this particular weaving process, where wet biology techniques are incorporated with textile techniques.

² As of 2014, in Ontario, Canada, “excised human tissue is private property and... belongs not to the person from whom it came but to the institution that holds it.” [3]

Formal Concerns

I mean to next address the fear and mistrust that not only reflects a perceived lack of competency with biological materials due to my being an (female) artist, but also, acts to dictate the form my work must take in display contexts.

In the *Biomateria* exhibition, I exemplified the extra labour and trust required of the bioartist, to not only work with fairly innocuous materials but also to display them publicly. I was required to display a Biosafety Level II biohazard permit that had authorized me to establish the mandatory containment lab in the gallery, designating me as Principal Investigator of the Black Box. Additionally, I was tasked with keeping all of my various biosafety certifications on site, representing several hours of extra training in the proper handling of live materials. Not only did these certificates have to be present, but so too did certificates of other “lab users” who served as backup if I couldn’t be reached in the event of a biohazardous incident, like a fluid spill.

Also required to be visible near the Black Box was an alarmingly brightly coloured biohazard sign. This sign publicly identified who was responsible for the potentially biohazardous materials and how to reach them directly by phone, as well as what Personal Protective Equipment (PPE) to wear. I wore a digitally printed silk version of this biohazard sign in the form of a crudely constructed dress, in order to indicate to gallery visitors I interacted with that human bodies posed more of a threat to my work than it posed to them.



Figure 3. *Sign/ Enseigne*, 2015. Digitally-printed silk biohazard sign, worn and performed.

I was soon after invited to attend the Public Health Agency of Canada's *1st Canadian DIY Bio Summit*, an initiative to address the (wildly) growing DIY bio movement and get a handle on unregulated use of biomaterials. This was another opportunity to perform my biohazardous self via the dress. Ironically, I was not allowed to showcase any live materials during the DIY Bio Fair.

In another gallery context, I was required by the director to procure a "Certificate of Non-pathogenicity". The curator displayed this official letter on the gallery wall, both to provoke and reassure the public. Regardless of this extreme measure, a gallery technician still reported having a physical reaction when unpacking my work (despite its double-containment), and stated concern for his physical wellbeing.

Protocols of Magic, Labour & Empathy

Asepsis is as much a cultural belief system as biological fact. The purity of the lab, its systems of regulation to ensure sterility and containment, are based on not only scientific notions but also a wariness towards the forces of nature, an understanding of the natural world based on a lurking, background religiosity that sees the body as a site of spiritual contamination, or the contamination of the logical categorization of things.

Keeping distance is the sanctioned protocol for working with biological materials, through architectural, bodily and bureaucratic barriers, as well as psychological barriers, to the extent of what I call, *emotional asepsis*. *Emotional asepsis* is a containment strategy meant to prevent the messiness of ethical conundrum, maintain anthropocentric hierarchies as well as quell (irrational) fears of contagion and death. But, it can lead to sensory handicap, as in a lack of feeling, or a lack of empathy for the material. Examining emotional asepsis gives us insight into categorical distinctions between a person and disembodied material originating from a human, who has the authority to make those distinctions, as well as gives us an opportunity to acknowledge epistemic limitations.

I have examined and executed *Biomateria* through two distinct but related feminist threads: *craft as labour*, from the perspective of Feminist Materialism and, *craft as agent* from an anthropological understanding of witchcraft, as a ritualistic interface for manipulating living systems towards the materialization of self-assembling and co-designing subjects. Within these frameworks, I address empathy as a lab technique, a rogue technique within a biotechnological context and an antidote to emotional asepsis, developed through slow craft and intimacy.

Craft and Micro-Community

Tissue culture work involves regular, long-term feeding and maintenance of billions of cells—a significant com-

mitment. In this light, one may question the necessity of using slowly handmade textile scaffolds versus readily available commercial fabrics. Aside from the fact that one can't very easily source hair cloth, the engagement of these frameworks for 'making' on the human scale with the life processes of the tissue culture on the microscopic scale is meant to serve as a mirror. The decelerated, deliberate action of hand-making tiny objects is crucial to an embodied understanding of the shared task of material learning and building haptic knowledge, a shared experience of physicality and its limitations.

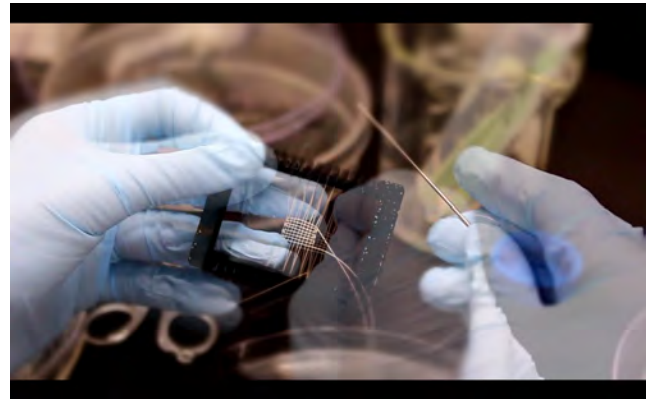


Figure 4. Video still from *Biotextile Craft*, 2017. [3:27]

Supporting active cell engagement with (and within) the textile scaffolds means working to maintain normal cell function while also influencing cell morphology and motility, enough to foster the building of fragile tissue layers on the structure. The agentic capacity of both my own and the micro-organic processes begins as a haptic epistemological potential, "the kind of potential that [here] originates not [just] in human initiative but instead results from the very disposition of things." [4]

Discovering a successful interaction between mammalian cell type and scaffold material is a form of learning and response conducted through the cell anatomy, as well as through the hand of the artist—a material fluency developed through intimate corporeal translation.

Natural 'indicators' contained within the protein composition of the fibres can help determine cellular activity.³ Other determinants include the tension of the warp in maintaining the spacing of the structure—woven to biomimetically resemble organic matrices of internal scaffolding. Also important, I discovered, are the intersection points of the woven structure—contact zones, or what we can perhaps even understand as information axes.

³ Researchers have discovered the existence of chemical indicators in silk, for example, which influence bone cells towards bone formation, making silk an ideal material for bone grafting technologies. [5]

The resourcefulness of these non-neuronal cells is displayed in how they anchor near the axes, and from there extend microtubules and actin fibres across the negative space towards each other, communicating chemically and through contact to collectively build multicellular bridges within the woven structure. As these bridges widen, the textile grid becomes the proto-skeleton for new tissue formation. The inkling that these cells might possess some form of intelligence, related to knowledge generation and communication can influence how we approach, categorize and work with them. It's here that an expanded relationship with microorganisms becomes an important consideration.

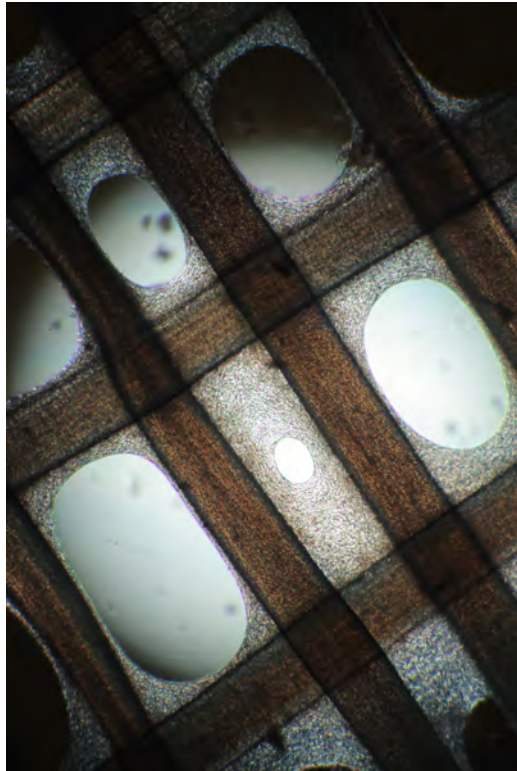


Figure 5. Micrograph of biotextile with live mammalian tissue formation, beginning at the intersection points of handwoven horsehair.

Feminist Materialism & the Expanded Textile Field

Technical research and production of biotextiles is already industrialized. It is, even, by some industry players designated as “craft”.⁴ The research around its applications is presented within traditional sci-tech and industrial frame-

⁴ For example, some of these industrial players include entities such as [Kraig Biocraft Laboratories](#), as well as those who also have co-opted the word “bio-art” for their corporate endeavours, such as [Bioart Creative Dental Technicians](#). The socio-cultural critical component of this work, as well as aesthetic predominance which would distinguish it as belonging in the field of craft or art, is missing. These examples are simply biotechnological.

works, focused on producing standardized, efficient and profitable outcomes. Such industrial activities retain a certain cultural remove, impersonal through their proprietary scale of mass production.

Creative iterations of biotextiles, simultaneously from outside and subversively from within the biotech research model, have been taken up by artists (particularly women artists) whose work references the traditionally feminine, domestic labour of textile ‘arts’ in questioning objective modes and sites of biotech production. The *Biomateria* project, like some of the biotextile projects before it⁵, is interested in the extended idea of relationship formed via labour between human and nonhuman, specifically how to personalize and politicize the metaphorically ‘cultural’ network that is the site of productivity in the materials.

Weaving is synonymous with community and its relational aspects. Ideas stemming from Marxism place the value of materials as directly connected to the social aspect of production: how many labourers did it take, how many hours of their labour, to produce it. This direct value designation system displaces value as being related to the end use or pleasure its owner gets from it, and instead recognizes the principality of the labourer(s).

The gist of the feminist materialist dialectic has been a focal shift towards the materialist substructure, particularly the role of community networks in shaping and maintaining socio-economic and -cultural production: the ‘Material Turn’. Feminist materialism looks at the ways in which women in communities share and generate resources through material practices, often as alternatives to a dominant economic system.

Artists have taken up the ideologies of the material turn to not only refer more literally to empathetic relationships with their artistic materials but also to think politically about the labour of art-making and the value of production. The conflation with Feminist Materialism comes from not only looking at art/craft production and the cultural worker as marginal, but the relationship of being hands on with materials in small scale production reflects a similar need for community building and knowledge sharing through creative networks.

A culture of cells is a micro-ecology—an environment, a community, a centre for knowledge and material production processes. To consider the agency of a culture of cells within a micro-ecology as a political force, in terms of its influence over production, is an informative alignment with a feminist appreciation for the value, and power, of slow craft and labour that is centred within a bodily framework. This is a required appreciation when working

⁵ Some examples include: [BioHome: The Chromosome Knitting Project](#) by Catherine Fargher; Carole Collet’s [Biolace](#) pieces; and, [Faber Futures](#) by Natsai Audrey Chieza.

creatively with cells, and a political resistance to the industrial and often exploitative impetus for efficiency. Upholding the relevance of the labour of craft, as an important reflective aspect of my biotech production, is part and parcel with recognizing *craft as agent* and agency through craft.



Figure 6. The artist/author crafting in the lab at SymbioticA International Centre of Excellence in Biological Art, University of Western Australia, 2014. Photo credit: Meghan Moe Beitiks.

The Witch in the Lab Coat

As a form of feminist deviance from the hierarchies of cultural norms, the witch is the artist, is the disruption of standards of institutionalized control over bodies. She shifts form through the boundaries of categorization, knowing no limits for bodily engagement, refusing containment. The figure of the witch is both a traditional knowledge keeper of life systems and pre-existing grassroots pharmacology, *and* an embodiment of the uncontrollable natural world: she empathizes with, understands and is one with the powers of nature and thus moves them—they become her tools and materials, in performing what we might call *magic* or witchcraft. From an anthropological point of view, magic is an interface methodology between human actors and nonhuman, unseen agents.

Principles of contagion predate knowledge specializations such as epidemiology or disease control. Contagion magic, often performed as a textile-based craft, utilizes clothing or hair from a targeted person to persuade the unseen forces of nature towards an outcome of wellness or disease, a nascent means of bio-cultural influence. Anthropologist Edward Tylor positioned magic as a methodology similar to science in approach, yet divergent in that a causal relationship is not 'proven' [6]. The figure of the witch might share a lot in common with the mad scientist, where madness is a surrender of the rational self in the realm of the invisible or unexplainable, unprovable other. The witch in the lab coat carries out her work partly through ritualized protocols, partly through empathetic technique via labour, intuition, imagination, and affectation, moving within the

fluid space of magic and its subtle potential for materialization.

Jane Bennett invites us to, "revisit and become temporarily infected by discredited philosophies of nature, risking 'the taint of superstition, animism, vitalism, anthropomorphism, and other premodern attitudes.'" [7] I ascribe these attitudes to a general state of witchiness, where ritual, repetitive actions are used to coax the agentic forces of things. Viewing work in the lab through the lens of witchcraft pokes at already existing ritual performance and magical thinking in scientific practice—for example, deductive reasoning, a series of premises and probabilities equating to 'proof'. The witchcraft framework also acknowledges that as with some of the methodologies, the goals of science, religion or spirituality mean to do the same thing: explain the forces of life, extend or manipulate life, and negotiate human suffering.

Conclusion

If part of this reading of the work is a romanticization of biological process and functional science, I ask what this deliberate romanticization might respond to. Going back to the idea of 'Machines and Men', that conflation of gender and techno-ontology that is still apparently the norm⁶, what might feminist materialism and witch/craft have to offer the world of biotechnology in terms of democratization? Can empathy be translated effectively to a feminist materialist reading of biotechnology? What might viewing work with cells in anthropomorphic ways through body politics provide? What insights might we gain with regards to our attitudes towards bodily matter as creative material but also, towards creative work as valuable labour with a role to play in the careful advancement of biotechnology?

⁶ I am assuming that the title of the article in question is a direct reference to the 1973 collection of sci-fi short stories by Keith Roberts [8], though whether the article's author was aware of this particular book, or simply grabbing a clichéd expression from the vernacular of popular culture, is uncertain. Surely, we as a culture have progressed further than this, with regards to gender norms and technology, in the last 45 years?

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Author Biography

WhiteFeather Hunter is a multiple award-winning Canadian artist-researcher, as well as educator, arts administrator, curator and writer based in Montreal. She holds an MFA in Fibres and Material Practices from Concordia University and presents her work internationally, most recently in Reykjavík, Berlin and various US cities, with forthcoming presentations in Helsinki.

WhiteFeather positions her BioArt practice within the context of craft and feminist witchcraft, via material investigations of the aesthetic and technological potential of bodily and vital materials. She hacks/builds electronics, uses web-based platforms to generate new mythologies, works in narrative video, and performance as embodied research.

WhiteFeather is Principal Investigator and Technician for the Speculative Life BioLab within the Milieux Institute for Arts, Culture and Technology at Concordia University and artist-in-residence at Sporobole centre en art actuel in collaboration with Dr Denis Groleau, Tier 1 Canada Research Chair in Microorganisms and Industrial Processes at Université de Sherbrooke.

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<https://goo.gl/387Yqb> (shortened link)

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https://issuu.com/whitefeatherhunter/docs/biomateria_for_is_suu

Hunter, WhiteFeather. *Biomateria; Biotextile Craft*. Lulu.com: Oct 2015. ISBN 978-1-132-86721-5
<http://www.lulu.com/shop/whitefeather-hunter/biomateria-biotextile-craft/paperback/product-22432465.html>

Representing Femicide Through a Video Game: Towards a Socially Responsible Design Practice

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KEYWORDS

Violence Against Women; Femicide; Game design; Level design; Activist games; Art Games.

1. INTRODUCTION

Video games typically fall in the category of entertainment media. However, their potential to provide commentary on real world events and issues is increasingly recognized and exploited. This paper is part of the development of *SOLA*, a video game that aims to represent the climate of tension, discomfort and fear experienced by many women in Latin and Central American cities where violence is part of their everyday life. In such places, violence against women is a pervasive and ongoing social problem that is found in the private as much as the public sphere. Femicide/feminicide refers to the ultimate link of a long chain of hate, disdain and violence entrenched in the mindset of a patriarchal and capitalist society where the female body is seen as exploitable and disposable. The extreme case of femicide/feminicide can be described as: “Unspeakable and unrepresentable forms of degradation and violation, both to the body and the being of women and girl” (Rosa Linda Fregoso). *SOLA* was created by Agustina Isidori with the collaboration of Etienne Brunelle-Leclerc. This video game is framed within Isidori’s wider Research-Creation work which is rooted on an interdisciplinary approach to curate subjects related to violence against women, with special attention paid to the extreme case of feminicide/femicide.

Given the sensitivity of the subject matter, the team strives to achieve this effect without resorting to mundane video game tropes such as graphical depictions of violence or trite scare tactics, e.g. the jump-scare. In this paper, we will consider two fundamental game design concerns—namely goals and level design—and examine how they can be leveraged to convey a stated of latent anguish in the players.

2. GENDER VIOLENCE IN VIDEO GAMES

According to ECLAC, the Economic Commission for Latin America and the Caribbean, at least 12 women from Latin-American and Caribbean die each day. A recent study done in 2016 showed that seven out of ten countries with the highest female murder rate in the world are located in South America. Countries such as El Salvador,

Colombia, Mexico, Guatemala and Brazil are amongst the first ten names in the list. Femicide is an ongoing war against women: in Argentina, cases of femicide have increased in number over the last years. In 2015, a woman was victim of femicide every 31 hours.

2.1 Serious Games

In *Critical Play*, Mary Flanagan asks: “What if some games, and the more general concept of play, not only provide outlets for entertainment but also function as means for creative expression, as instruments for conceptual thinking, or as tools to help examine or work through social issues?” (p.1). Flanagan proposes to see games as artistic, political and social critiques or interventions to highlights larger cultural issues. *SOLA* sits somewhere between what Ian Bogost describes as “artgames”, characterized by representing an experience, a way of experiencing the world through a particular lens, and the notion of “activist games”, focused on social issues and education (Flanagan, 13). *SOLA* starts with a black and white short film shot on a train. While the train moves, the windows reveal the darkness of the night escorted by the city lights. The character walks freely in a rainy city, while the dark streets are filled with an eerie and thick atmosphere. Throughout a low-key bluish almost black and white visual style and influenced by an aesthetic borrowed from film noir, the game evokes a climate of fear and tension. *SOLA*’s ambition is to represent the climate of fear, menace and vulnerability experienced by a woman walking alone at night.

3. GOALS

According to the authors of *Rules of Play*, “a game’s goal is a central feature of its formal system” (Salen & Zimmerman, 2003, The MIT Press). It thus follows that player goals are a good place to start when designing a video game since other game design components will converge to steer the player towards them. However, goal-setting turned out to be more problematic in the case of this project, mainly because of its socially relevant theme. The player (playing as a female protagonist) was first assumed to have to get home, since the notion of home usually holds a sense of safety and shelter. However, this is not the case for many women who are victims of domestic violence. *SOLA* is a serious game project about experiencing a woman’s perspective walking alone in the streets at night. In *SOLA*, an important design decision is the framing of the character’s destination: is the character

heading home? Is home a safe place? Is the city environment a threat for a woman? The process of designing this game triggered a discussion about the design and experiential implications that reside in the seemingly unproblematic notion of a game's "goal".



Figure 1. *SOLA* Menu

3.1 Discussing home as the game's objective: Is home safe?

Home has a deep emotional meaning, it is the place that we share with our families, a space that we nurture with love and in exchange it provides us with shelter and an illusion of safety. What happens if we remove the emotional aspect? Is it still a home or a merely physical structure? The meaning of home can easily vanish. What happens when this shelter, our home, becomes an active agent associated with our own suffering and traumatic experiences? The warmth of home is lost when the walls become witnesses of torture. For many women, home is a space related to alienation and emotional turmoil. Victims of domestic violence may experience home as the scenario of their own nightmares. Nightmares that are lived on a daily basis, nightmares in which the protagonists can be partners, husbands, brothers or even fathers. Nightmares that will, without doubts, leave eternal scars on the victim's body and memory.

Socialist feminists claim that the domestic sphere is the space where patriarchy gains strength. Expanding on the Marxist research on home, they claim that: "capitalism produces inequality in tandem with patriarchal relations and ideologies that position women as inferior to men" (Blunt & Dowling, 16). Home can be a key site in the oppression of women: "As a symbolic representation, home 'serves to remove women from the 'real' world of politics and business" (Blunt & Dowling, 15). Defining home as the final objective for the game would imply that home is a safe space for women, and this is far from the truth. Home can be the most lethal place for a woman: "The vast majority of incidents of violence against women take place in the home or other private and semi private spheres. An accurate map of urban rape would highlight far more bedrooms than alleyways and parks" (Pain 1997: 233, qtd. in Blunt & Dowling)

3.2 Re-Victimizing the Victims. Women, Home and City Environment

What are the effects of setting home as a final goal for this game? Are we telling women and girls that they should stay home if they want to be safe? And what are we saying to those women who are not home? Are they responsible for being abused, tortured or murdered? By setting home as the game's objective, the underlying message of this game would seem to be: *be safe, stay home*. This section is focused on examining how, through a design decision, we could contribute to the continuation of a structure that propagates gender inequality and reinforces a victim blaming system where women are categorized and re-victimized by the media according to their social life, status and education.

In order to understand and foresee the dormant implications of guiding our female character home, we could consider the representation of women in art throughout history and how it echoes in prevalent prejudices about women. This apparently risk-free design decision about the game's final goal could trigger a misinterpretation of the game, and most importantly, contribute to the maintenance of a structure built with prejudices and preconceptions. The role of women in the private and the public sphere has been extensively represented throughout the history of art: in painting, literature, cinema, and so on. We could think about the role of women through Rembrandt's painting *Philosopher in Meditation* (1632), in which, while the male character, the philosopher, sits in a highly illuminated corner of the frame bathed by some sort of inspirational light, on the opposite corner of the painting, we find a woman preparing the fireplace, which will probably use to cook a meal. Or we could consider the dichotomy in the representation of the role of women in the melodrama genre in Argentinian films during the 30s and 40s. In these films, women were portrayed either as the virgin, the good wife, the saint mother, the well-educated-religious young lady, related to the house and good values, or as the impure woman, corrupted by the night, the street and bad habits (Lozano, 6). All these representations were packed with preconceptions used by the film industry to support the foundation of a genre. Do these representations resonate in the present? Do they contribute to the way in which mass media portrays and frames the good and bad victims of femicide? (Arduino, 1)

By guiding our female character home we would be promoting and disseminating the dichotomy between safe/unsafe, private/public, street/home, which contributes to the perpetuation of a patriarchal structure that supports rape culture and re-victimizes women. In its surface, *SOLA* portrays the experience of a woman walking alone on the streets at night, however, underneath this surface, an inaccurate and dangerous message could be hidden.

3.3 Depicting a South American City: The Risk of Trivializing Violence

Let us imagine that we use home as the game's destination. We would have point A and point B. Point A being the exit of the subway station and the beginning of the player's interaction with the city, and point B being home. Point A and B would be areas depicted as safe spaces, free from

obstacles and unforeseeable dangers. According to this structure, everything in between point A and point B would be an unsafe and dangerous area. Ergo, street/city equals danger, or in other words, South American cities are dangerous. The purpose of this game is by no means, to instigate fear and to represent underdeveloped countries as threatening and unsafe places. I stand against the trivialization of this issue for sensationalist purposes. We cannot deny that these countries have an ongoing lack of public security, however, this is not the message that I want to convey with this game.



Figure 2. *SOLA* during play.

3.4 Moving forward

When discussing what ‘home’ should be replaced by, we asked ourselves how the player’s goal could best contribute to the aesthetic that we had in mind. This is where our approach differs from other attempts at putting values into play such as Ian Bogost’s procedural rhetoric (Bogost, 2007). Our game is less about having the player decipher the message that is encoded in the game’s operations and more about having them experience a *climate of fear* where otherwise mundane occurrences take on a sinister dimension. Here, player action matters less than the context in which it is held. Similarly, this game does not strive to have players experience a sense of agency over the game world. In fact, it strives to do the opposite. Thus, player goals are not as essential to the player experience as they would be in another game.

While we were aware that most players would be looking for directions as to what they were supposed to do, we eventually realized that not giving them a clear direction, would create a malaise which we could leverage as a source of meaning. There is in fact nothing that the player can do to resolve or remove themselves from the situation they find themselves in. They can only keep walking and sample the range of fears that the threat of abject violence can inflict on the mind. The lack of a clear direction might prove frustrating to some players, which goes in hand with the feeling experienced by many women in cities where street harassment and violence are embedded in their everyday routine. After all, even Salen and Zimmerman acknowledge that “goals are not the only reason people play games.”

4. LEVEL DESIGN

Level design is a critically important area of video game design since it is where all of the individual parts that make up a video game are brought together in a cohesive whole. However, its contribution to the player’s experience is not limited a harmonious integration of disparate elements. The space that hosts play has expressive properties of its own. When deciding on how to best convey a feeling of latent tension and anguish while staying true to the ethos of our project, we realized that the expressivity of the space was something that we could leverage to our ends. In keeping with our refusal to provide the player with explicit directions, we opted to make the level open and non-linear. We also chose to have the game take place at night during downpour so their vision and their hearing would be impaired, furthering their sense of helplessness and dread.

4.1. Architecture and Human Psychology

In an article published on game industry website Gamasutra, architect Christopher Totten highlights the connection between human survival instincts and the way human beings relate to different kinds of spaces. Borrowing from fellow architect Grant Hildebrand’s work on the aesthetics of architecture, Totten discusses three categories of spaces. Narrow spaces where our senses are impaired and where we are unable to move properly make us feel vulnerable (Totten, 2011). In the context of level design, we feel that the previous statement can be generalized into the following: spaces that make using the game’s controls and mechanics difficult or awkward will increase discomfort in the player. Although one must be careful not to overstep the line between discomfort and immersion-breaking antagonism, incorporating narrow spaces in the layout of a level is one of the ways level design can introduce a sense of tension in the player’s experience. Conversely, a space that is too wide and open may also induce discomfort in players because it will make them feel exposed to potential threats. Hildebrand and Totten call this kind of space a prospect space and the latter suggests that such a space may evoke a feeling akin to agoraphobia (Totten, 2011). Intimate spaces are “neither confining nor overly large” and are meant to make the player feel in control (Totten, 2011). In level design terms, these spaces should fully support the game’s mechanics and afford courses of actions that the player is able to recognize and act out. In a more general sense, these spaces should be imbued with the aesthetic qualities that the game employs to serve as counterweights to vulnerability, threat and tension. Since our game is meant to make the player feel uncomfortable, we designed the level so that it only consists of spaces that are little too narrow or a little too wide. There is nowhere for the player to feel a sense of safety or control.

5. CONCLUSION

SOLA aims to create an atmosphere of tension, discomfort and anxiety, those feelings that many women carry with them while walking the streets at night. The dense and

thick atmosphere and the ambiguity of the game's goal goes in hand with the uncertainty felt by the player while walking the streets of this eerie city. In *SOLA*, the doubt of not knowing what could happen is felt as an almost tangible burden, the burden of being continuously alert while doing something as simple as walking. Walking the streets of this city becomes a matter of how do we want to experience our fear.

Violence against women is supported by patriarchal and capitalist structures that are reproduced and perpetuated in everyday actions and naturalized preconceptions. As designers and artists in the process of designing a game dealing with delicate subjects, such as violence against women and femicide, we must be aware and responsible for the meaning and implications embedded in our work.

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Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Two Women: On the Cinematic Experience in Installation Art

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Abstract

Two Women is practice-based research, which utilizes a hybridization of film, installation art, electroacoustic composition, algorithmic narrative, and kinetic machines. The piece thematically addresses the invisible crisis of an old Korean woman in a framework of a fictional narrative, accompanied by a database of historical news archives. *Two Women* attempts to depict multiple layers of imagination, memory, and history in a physical space. In the piece, time is experienced as a fragmented, spatially distributed, and non-linear concept. *Two Women* investigates several research trajectories, which constitute the technical, artistic, foundations and process for the artwork.

Keywords

New media art, algorithmic narrative, cinematic art, kinetic art, databases, embodied vision

Project Description

This writing describes the artistic research and practice of realizing cinematic experiences in the realm of installation art. *Two Women* is a dissertation project for the Doctor of Philosophy degree in Digital Arts and Experimental Media at the University of Washington. The project is a collaboration between James Hughes and Ha Na Lee.

Two Women portrays an individual's experience of psychological and physical trauma through a poetic narrative. The work recreates the story of the events leading up to the suicide of Lee's 73-year-old Korean grandmother. Although the motivation of her suicide is unknown, the story searches for possible reasons to understand her death. The unsettled mind is a crucial narrative force. The intimate interactions and interrelationships between the protagonist's body and symbolically loaded objects and contexts evokes themes of repression, resistance, submission, resignation, power, melancholy, death, and violence. The disembodied female voice in gallery space leads audiences from place to place while it unfolds fragmented, fragile, and secret stories in the manner of magical realism.



Fig. 1: *Two Women*, installation view at Currents International New Media Art Festival in Santa Fe, 2015. For video documentation visit: <https://vimeo.com/132284046>

The installation space is a cinematic realization of this fantasy, staged as a domestic room in a state of decline and despair. A pair of kinetic machines dominates the space. The machines record suicide-related news stories as Morse code physically punched on a roll of black paper. Each roll of punched paper slowly feeds into a pool of water where it forms a perforated projection screen for videos of women submerged under the water. The paper is pulled up to the ceiling where soft light reveals the structure and pattern of the punched holes.

The narrative is interwoven with selected news stories about suicides culled from Korean newspapers dating as far back as the 1920's. The narrative and the stories are projected as subtitles on each of the punching machines - Korean on one machine, and English translations on the other. The piece is driven algorithmically, with the movement of the machines, audio, and video progressing in concert with, and reinforcing, one another.

Each iteration of the story lasts between eighteen and twenty-four minutes including four fictional chapters and three news documents. A twenty second pause occurs between each iteration. During a typical eight-hour continu-

ous exhibition time, the news stories never repeat, and the machines continuously punch rows of holes in the form of Morse code.



Fig. 2: Two Women, displaying news archive, installation view.

There are two video modes for each machine: the news archives and the fictional narrative. The subtitles are projected on the paper before it enters the punching machine. The cinematic video is projected into the water onto the submerged paper after it is punched.

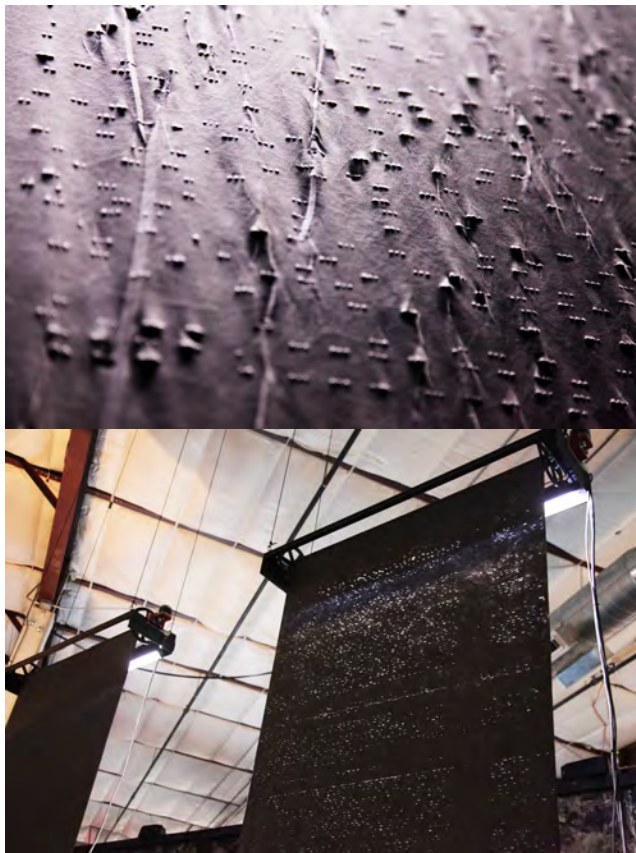


Fig. 3: Two Women, front and reverse view of the perforated paper.

Contexts for Research

Embodiment, The Senses, and Spectatorship

The study of vision has a long history in Western visual art. The tradition extends continuously from the Renaissance study of linear perspective, to photography and cinema, all the way to contemporary computer vision research. The purpose of this study is a quest to portray the physical world objectively and acquire verisimilitude in representation. For the past few thousand years, the model of the camera obscura was held as the reference for objective representation. Thinkers such as Euclid, Aristotle, Roger Bacon, and Leonardo da Vinci meditated on how the camera obscura could provide guaranteed access to the objective truth about the external world. [1]

René Descartes advanced a very influential idea about vision, “the Third Meditation” [2], which proposed a rejection of human sensory perceptions in favor of mechanical and mathematical representations of the world. His method was to shut down all the senses, including the eyes, in order to truly observe the world. To Descartes, human eyes were uncertain to acquire true objective perception. The camera aperture’s single vantage gave the most accurate point of view to the world.

The film *The Draughtsman’s Contract* (1982) directed by Peter Greenaway played with the flawed concept of objective vision, and realistic representation, in the baroque period. The story begins with the protagonist Mr. Neville being hired to create twelve drawings of the patron’s estate. The protagonist wants to acquire a perfect and meticulous image by using mathematical measurements. Throughout the film, he is frustrated and confused because his observed subjects are constantly changing, displaced, and chaotic. His thoughts and relationships evolve with the associated objects and people. Greenaway draws our attention to the impossibility of true objectivity.

Art historian Jonathan Crary argued the camera obscura model collapsed in the early nineteenth century because of the status of an observer’s body. Indeed, this model was replaced by radically different notions of an *observer* and what constitutes the senses. Crary cited Goethe’s *Theory of Colours*, and a new science of physiology, as evidence of this shift away from objectivity, toward new models of embodied vision, multisensory perception, and spectatorship.

Goethe’s *Theory of Colours* describes how the human body involuntarily produces optical experiences within the visual system, with phenomena such as the *afterimage*. Goethe’s interest in the afterimage reveals a great deal about the subjectivity of vision. [3] The body has its own agency to produce and generate visual experiences.

The development of the science of physiology was also a crucial factor of dispelling the idea of objective vision in the early nineteenth century. German Physiologist Johannes Müller’s discovery of nerve energies observed that each of the five senses had a unique corresponding, and physiologically distinct, type of nerve. In Müller’s experiment, electricity, pressure, and mechanical stimulation of

the retina all produced luminous sensations. [4] The experience of light had no connection to actual light, therefore vision could no longer be understood to be always representative of actual objects in the world.

The status of the observer triggered a significant paradigm shift in the discourse of vision and representation in Western philosophy and art. It is true that ideology behind the camera obscura led to the prolific inventions of photography and cinema, however our cognitive perceptions are not only acquired by sight, but also by embodied vision. In Crary's account, he calls this new integration of the subjective ground of vision a "corporeal" concept of vision. This acknowledgement of corporeality was one of the most pivotal shifts in the history of art, especially in the context of media artists. The cinematic experience is deeply entangled in the notion of corporeality.

The early cinema phenomenon "cinema of attractions," [5] a term coined by Tom Gunning, describes a fundamental way of understanding embodied spectatorship. Gunning writes, "the cinema of attractions solicits a highly conscious awareness of the film image engaging the viewer's curiosity." [6] Avant-garde films in the years between 1906 and 1907 celebrated the moving image as an end unto itself. The technological innovation was so novel, and so different from anything which came before, the content was almost irrelevant. The moving image could stand on its own.

The observer also brings his or her own experiences to bear on any process of observation. Henri Bergson was interested in how a body mediates perception and memory. Based on Bergson's the notion of sense perception, film theorist Laura U. Marks noted,

Perception takes place not simply in a phenomenological present but in an engagement with individual and cultural memory. Attentive recognition, I suggested, is thus a participatory notion of spectatorship. We move between seeing the object, recalling the virtual images that it brings to mind, and comparing the virtual object thus created with the one before us. [7]

In her book *The Skin of the Film*, Marks promotes embodiment and the senses in cinema, especially the notions of haptic visuality and tactile images. Haptic visuality is a way of looking which lingers on the surface, provoking a feeling of an object which could almost be touched. Techniques of cinematography which induce haptic visuality include: extreme close-ups, camera movement, under/over exposure of images, and use of aural textures.

The film *Hiroshima mon amour* (1959), directed by Alain Resnais and written by Marguerite Duras, depicts a stunning opening sequence which demonstrates haptic visuality and cinema of attractions. The shot features a low light setting, a close up of glowing dust or ashes showers down to cover two cropped bodies intertwined and locked in an embrace. At first, the sequence of images appears

abstract, and the bodies are unrecognizable. Then, gradually, the viewer pieces together the textural images of the dusty bodies, which recall the remnants of death and war.

Though the film doesn't explain or provide any narrative contextualization, the viewers sympathize and immediately comprehend the traumatic situation through the images. The fragments of traumatic memory are conveyed by the protagonist's dialogue, while the cropped body images, and a series of montages, interplay with the past and present scene of Japan after World War II.

Patty Chang's performative video piece entitled *Eels* (2001) begins with Chang sitting on the floor and positioned upright against a wall while she is staring at the camera. She's visibly irritated and uncomfortable, but the source of this discomfort isn't immediately evident. There are some clues, such as water stains on her blouse, but suddenly her torso comes alive with a coiling and uncoiling eel inside her shirt. It's pretty difficult not to project yourself into the scene and imagine how you'd feel in the same position. The movements of the eels, the squirming, moaning, and grimacing, all flow through the screen transcending the limits of sound and light, and generating haptic visuality.

Fabrication

The physical configuration of *Two Women* consists of a freestanding L-shaped wall (192 square feet of space) covered with wallpaper, a dark carpet floor and two identical kinetic machines. Each machine is, roughly, a spool of black paper which runs, from the floor in front of the machine, up over a short length of table top, under a linear rail which positions a punching tool, into a pool of water, across the bottom of the pool, and then up to the ceiling where a spooling mechanism collects the paper.

The punching system shares a lot of its design with contemporary CNC machines such as 3D printers, or CNC routers. The main horizontal structural member of the punching system is constructed out of wood to minimize the industrial look. To the wood beam, a conventional off-the-shelf linear bearing rail is mounted. The block on the linear rail has a custom-made bracket with the solenoid attached.

The solenoid has a custom-made puncher awl (Fig. 5) affixed, and custom-made dampener to silence the piston when the solenoid is de-energized. The method for powering the solenoid is somewhat novel. To either side of the linear rail 3/16th inch metal strips are inlaid into the wood running the length of the wooden beam. These metal strips are the positive and negative rail used to power the solenoid. The wires to the solenoid are attached to a pair of spring loaded electric brushes which bridge the electrical gap between the block and power rails.

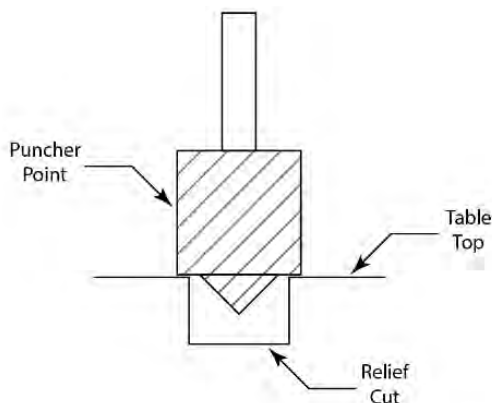


Fig 5: Detail of the puncher awl and its relationship to the relief cut groove in the tabletop.

The linear rail block is positioned by a timing belt which is driven by a stepper motor. A lead screw was considered for this purpose since it would have further reduced visual clutter, but the belt drive won out because it could move the solenoid around more quickly and be easily positioned by hand when the stepper motors were unpowered. A limit switch at one end of the linear rails provides a mechanism to “home” the punching system when the whole machine is started up. This homing routine assures the punches are punched at precise distances with respect to the location of the limit switch.

The spooler system is constructed out of a simple 80/20 brand aluminum extrusion frame and bolts together. The frame is hung from the ceiling by black parachute cord at 4 corners. The rigging is made from one continuous piece of parachute cord such that tension on the frame from the paper pulling downward causes the frame and spool to self-level.

The spooling system is driven by a stepper motor with 30:1 worm gear reduction. The worm gear system cannot be back-driven so the system maintains tension on the paper even if the stepper motors are powered down. The worm gear and stepper came as a single pre-packaged unit and included a drive axle. The motor is bolted into the gear reduction unit. The gear reduction unit is bolted to a custom-made aluminum bracket, which bolts onto the spooler system frame.

The black Tyvek paper used in the installation is 48 inches wide. Each roll is 375 feet long. The diagram (Fig. 6) demonstrates the entire transport route of the paper through the installation. Gravity, friction, and tension are all crucial to correct movement of the paper. The fresh roll of paper at the foot of the installation is mainly held in place by the rolling action of the roll as the paper is being pulled upwards onto the machine body. The friction caused by the table under the puncher, and the 4 right-angle turns of the paper as it moves through the system is important to keep the paper taut and smooth, as well as submerged beneath the water (Tyvek floats). The tension on the system also creates a visual tension since you can actually see the stress on the paper.

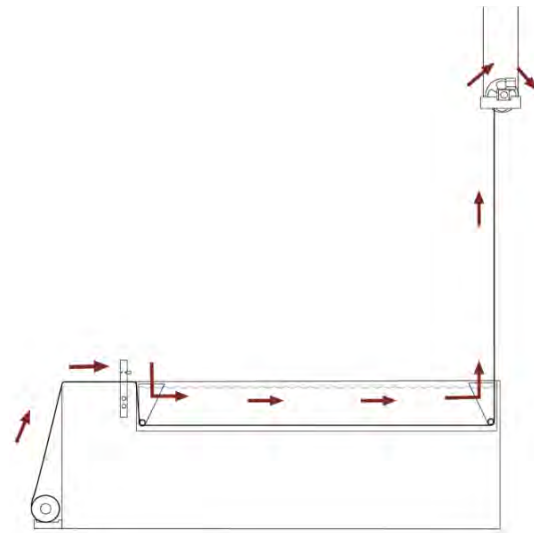


Fig 6: *Two Women* diagram side view with flow direction

Electronics

Each machine has two video projections. The diagram (Fig. 7) demonstrates the location of the projectors in relation to the machine. The pico-projectors are hung 70 inches above the punching table and only project subtitles. The other projector casts full 1080p HD size video clips into the pool of water.

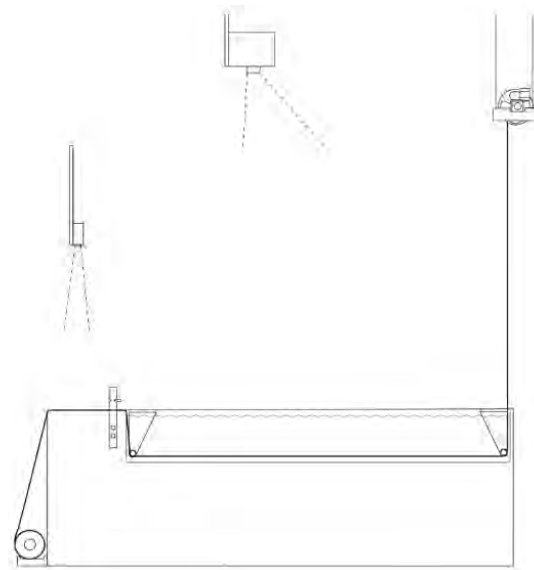


Fig 7: *Two Women* diagram side view with video projections

Each projector has a dedicated Raspberry Pi 2 (RPi) running custom software written in C++ to play the video. The RPis are networked together with Ethernet. The RPis run the subtitles received via Open Sound Control (OSC) and have no local store of text. The computers running the HD projectors have a local store of pre-rendered video

clips on a flash drive and receive OSC commands to tell them which video to play.

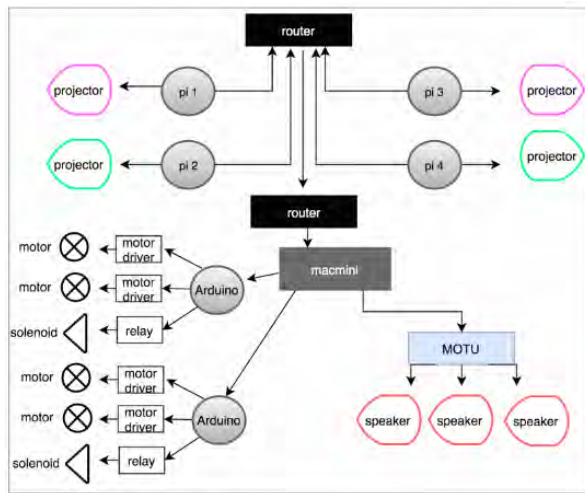


Fig 8: The diagram of electronic device connections

The main composition is written in SuperCollider running on a Mac Mini and networked to the rest of the installation. SuperCollider generates the sound and uses OSC to send commands to the video players and the punching machine. A collection of shell scripts are used to start up the various subsystems and to reboot and shutdown all the machines in the installation. Each part of the system may be easily controlled from the Mac Mini by an exhibition docent in the event of system problems.

Despite the power and convenience of the RPi's, the non-subtitle video playback has some technical problems. Every once in awhile the videos inexplicably freeze, probably due to a bad interaction between the OMXPlayer firmware and the video encoder used. Also, the SD Card throughput on the RPi's is severely limited, which results in a noticeable gap between sending a command to start playing and video and when the video actually starts to play. During this gap, the last frame of the previous video remains frozen on-screen. The gap is probably less than a second but it has the effect of breaking the immersive experience of watching the video. The RPi is capable of full frame rate 1080p video, but to achieve this performance the videos have to be compressed in a way which leads to quite a bit of compression artifacts and loss of clarity. Due to these problems, the RPi's were replaced with Mac Minis for HD video playback for subsequent installations.

System Design

The main control system for *Two Women* was adapted and extended from a previous project, *Vestiges, part III* (2012-13), which controls several computers coordinating multiple channels of audio and video, and processes sensor input to generate algorithmic video.

The system can scale to an arbitrarily large number of audio and video playback nodes by the addition of more computers to the network. All of the elements of the system talk to each other through Open Sound Control (OSC) messages over a TCP/IP network.

The *Two Women* system is composed of a handful of special purpose programs, which are orchestrated together by SuperCollider. The diagram (Fig. 9) shows the flow of data through the system. Each of the blue colored boxes in the system represent discrete programs which run autonomously, waiting for data or commands from SuperCollider to perform tasks.

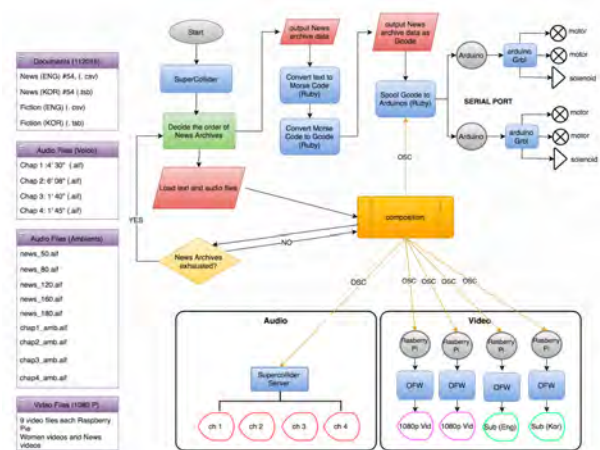


Fig 9: The system flowchart

The boxes labeled *Spool Gcode to Arduinos* and *arduino Grbl* represent the puncher/spooler subsystem. The Arduinos run a stock version of Grbl¹, which is an open source CNC controller. The functions of a CNC controller are mapped onto the installation rather straightforwardly. The linear rail is represented by the X-axis of control, while the spooling mechanism is controlled by the Y-axis of control. The puncher is represented by the coolant on/off control. Grbl is controlled by Gcode, a numerical control programming language which is widely used for computer based manufacturing machine tools.

Spool Gcode to Arduinos is a small Ruby program which handles parsing and converting the news files into Gcode and feeding the Gcode to the Arduinos over a serial port. The screenshot of a portion of the Ruby code below (see Fig. 10) demonstrates the functions of calculating distances of x and y movements as well as generating Gcode commands.

¹ Grbl, <https://github.com/grbl/grbl>

```

# defaults
@x_feed_rate = 5000
@y_feed_rate = 500
@x_pos = 0

$\ = '\n'
@sp = SerialPort.new(serial_port, BAUD_RATE, DATA_BITS, STOP_BITS, PARITY)
at_exit { @sp.close }

while (i = @sp.gets) do
  logger.info i.chomp!
  if i =~ /unlock/
    logger.info "ready"
    break
  end
end

def dot
  move_x(x_pos + dot_spacing)
  punch(punch_pre_pause, punch_mid_pause, punch_post_pause)
end

def dash
  move_x(x_pos + dot_spacing)
  punch(punch_pre_pause, punch_mid_pause, punch_post_pause)
  2.times do
    move_x(x_pos + dash_spacing)
    punch(punch_pre_pause, punch_mid_pause, punch_post_pause)
  end
end

def home
  @x_pos = 0
  stream("$H")
end

def move_x(pos, feed_rate=x_feed_rate)
  if pos >= MAX_WIDTH
    next_line
    return
  end
  @x_pos = pos
  stream("G90")
  stream("F#{ feed_rate }")
  stream("G1")
  stream("X#{ x_pos }")
end

def move_y(pos, feed_rate=y_feed_rate)
  stream("G91")
  stream("F#{ feed_rate }")
  stream("G1")
  stream("V#{ pos }")
end

```

Fig 10: Screenshot of a portion of code from the Gcode spooler

In order to maintain some real-time control over the punching system, the Ruby program has an OSC interface which listens for ‘start’, ‘stop’, ‘auto’, ‘manual’, and ‘tick’ messages. Start and stop turn the system on or off. Auto and manual put the system into different modes. In manual mode, the system will queue up a command but won’t execute it until a tick message arrives. This allows SuperCollider to control the timing of punches and moves. In auto mode, the punching machine handles its own timing and rhythm and needs no input or control from SuperCollider to run. The Ruby program adds some randomness to the timing of moves and punches in auto mode to help give the system the perception of some agency, and a more organic feel.

The punching subsystem consumes news articles which are pre-processed into symbolic Morse code made up of periods (representing dot), dashes, and spaces. A script handles mapping strings from the database of news articles

into this symbolic form. The intermediate form is useful for debugging, because it’s easy to visually compare with the punched paper output to see if it is correct.

The video subsystems are split into two separate programs. One program renders subtitles, which are sent over OSC. It handles formatting, spacing, and has some animation capabilities for displaying and wiping the text line by line. The system has no other notion of duration and is completely dependent on OSC messages to sequence and time subtitles display. The other video subsystem only plays videos. Since the videos are large, they are stored locally on each playback machine. OSC messages control which video is being played.

SuperCollider² handles the audio subsystem and serves as the main composition tool for coordinating the disparate parts of the installation. SuperCollider is a really effective language for composing time and scheduling events.

The composition system determines the content and duration of all of the other subsystems. It sends subtitles for display, controls video selection and playback, as well as audio synthesis and playback. When one cycle of the whole installation playback is done, the system re-scrambles and re-orders the news archives (see Fig.11) and begins again.

```

if(i == numArchivNews, {
  indexArray = arrayNum.scramble;
  indexArray.postln;
  i = 0;
  indexArray.size.do{|arg i;
    ~time.put(i, ~k_news_dur.at(indexArray[i]));
  });
  ("index: " + indexArray + " " * ~time).postln;
});

```

Fig 11: Screenshot of SuperCollider code

At least four different programming languages were used to implement *Two Women*. Each language has distinct advantages which make it well suited to a particular task. SuperCollider is really great at composing in the time domain, handling real-time events, audio, and controlling other systems via OSC. Ruby is superior at text processing, and can be rapidly iterated on because it is a scripting language. C++, while difficult to use, is a high-performance language so it was used for speed-sensitive critical code, such as a video playback.

Narrative / Composition

Two Women oscillates back and forth between two modes of storytelling. The first mode is that of the old woman. The narrative of the old woman is written in a style of open poetic language and it proceeds linearly within a chapter. The temporal relations between each chapter are not linked but rather remain ambiguous. The chapters are called in a

² SuperCollider is a programming language for real time audio synthesis and algorithmic composition. For more information, visit <http://supercollider.github.io/>

numeric sequence, but they are not necessarily experienced linearly. In other words, the audience doesn't have to hear any previous chapters to fully understand the current chapter.

Each chapter has a theme. For example, chapter 1 is about the narrator. She talks about her room in descriptive language. Chapter 2 describes her surreal dream and her reactions to confronting two punching machines. Chapter 3 and 4 reveal the moment of meeting her younger self. Then she sees her younger self drowning and she feels both fearful and comforted. The total duration of all the chapters in this mode is about 14 minutes. The chapters were written in Korean, and translated into English.

The second mode is made up of a database of news archives culled from various Korean newspapers between 1920s and 1990s. The news articles were specifically picked to echo a similar demographic as my grandmother: a minority, a female, a senior and etc. The individual characters of the selected news articles are counted to provide a rough metric of the needed display duration of each subtitle.

The total duration of each iteration of the entire piece is variable due to the news durations, though it typically falls in a range between 18 and 24 minutes. The flexibility of playback duration was created to support the addition of real-time news feeds, though that feature was cut due to the overall complexity of the work.

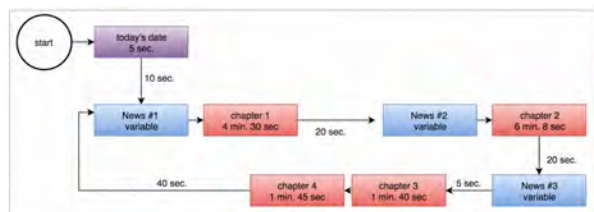


Fig 12: Composition diagram with duration and intervals.

The interplay between the news archive mode and the fictional story (see Fig. 12) echoes a cinematic technique called 'intercut.' Intercut is a technique to alternate two scenes, or shots, back and forth to make one composite scene, which occurs at the same time. The consequence of intercut is to unite two different temporal and spatial elements together into one scene. The narrative of history resides in her room while her own story unfolds in the present.

Each segment of the composition is time stamped with a date and year. The chapters about the old woman show the passage of time on the day of March 8th in 2006, the day she died. The text associated with the old woman is displayed in a format similar to subtitles for movies. The text is broken up into segments of approximately 32 characters (or less) and synced up to the audio track.

Video / Sound Compositions

Video

There are four different types of videos: abstract, wallpaper, a woman in a traditional dress, and a woman in a contemporary dress.

For the abstract video, the idea is to mimic fabric floating over the water which dissolves into particles which move around like water. The abstract videos are generated with a plug-in called Trapcode in AfterEffects. The plug-in takes an obj file, a simple data-format which represents 3D geometry, and generates particles based on the form.

For the entire 4 minute and 30 second duration of Chapter 1, both machines have wallpaper images. The video is constructed based on one still image. The process of creating the wallpaper image was to take a snapshot of the actual wallpaper in the installation and composite a small window into the scene. The image of the wallpaper works well because the story describes things the narrator owned inside of the room. The room is surrounded by distressed dark wallpaper. Projecting the wallpaper onto the surface of water is like a reflection. And ultimately, the pool of water is like a mirror.

The wallpaper slowly fades in over the duration of 2 minutes. This extremely slow fade in is designed to focus the audience's attention of the female voiceover. The agonizingly slow appearance of the image draws the viewer in because it's impossible to resolve the image until it's almost done with its fade in. To intensify the experience, virtual water drips into the pool from above creating a moment where the audience can't tell what's real and what's virtual. This effect adds another dimension to the image.

The film *La Jetée* (1962) by Chris Marker uses this technique of still image and moving image together effectively and brilliantly. The technique is even conceptually tied to the story. The entire film is constructed as a series of still images. A few seconds of moving image appears when the woman, who the main character loves in his memory, blinks her eyes. Here, a still image and a moving image implies the passage of time. In *Two Women* the encounter of water ripple brings the audience's attention the stillness which came before.



Fig 13: Still images of Chapter 1 video; wallpaper and wallpaper after water ripple.



Fig 14: Still images of Chapter 2 video

The Chapter 2 video interacts with the voiceover narration. In the story, the narrator is in her room where she can hear the sounds of machines. She sees two machines occupying the front of her room. She is terrified yet curious to explore what the machines do. She doesn't know exactly what is happening, and describes the look of the machines. While exploring, she finds a coffin-like bed of water in which her younger self lays submerged.

The women (see Fig.14) in each pool represent polar opposite dualities of traditional/contemporary, light/dark, and resigned/resistant-fearful. The woman in the contemporary dress on the right machine constantly pulls her body into a fetal position, whereas the woman in the white traditional dress looks comfortable and calm.

In the story, when the old woman discovers the women the water, the woman in the white dress cuts into a medium size shot. She opens her eyes and reaches out her arm while mumbling. This is the only point where this chapter

of the video responds to the audio and engages with viewers directly.

All of the video in Chapter 2 was shot from a point of view looking downward. This downward view mimics the audience's point of view and supports the illusion of a woman submerged in the pool.

Chapter 3 has similar gestures as Chapter 2, but focuses more on the feeling of fear the woman dressed in black. She has a series of gestures to shrink, cover her face, and go down deeper in the water while the woman in the white dress looks a bit pained, but calm.

Chapter 4 videos show moments of falling deep into the water and has a momentary shot inverting the plane of view where the light outside can be seen from a point of view shot beneath the water.

Since there are physical limitations of pressure, buoyancy, and the pool's depth, it was challenging to create the sequence of the women sinking deep into the water. The movement of falling was difficult for the actor due to water pressure, so computer animation was applied to intensify the gesture.

Sound

In *Two Women*, there are several layers of sound elements: ambient sound for news, the female voiceover, and mechanical sounds of punching machines. As previously mentioned, the composition of ambient sound is influenced by the sound of paper. With an ambisonic microphone technique, multiple clips of paper flapping and crumbling were recorded. Using the Ambisonic Tool Kit (ATK) in SuperCollider, the sounds are spatialized, composed, and processed.

The machine sounds are recorded with a contact microphone, and applied to the back track of the ambient sound. Multiple layered sounds are created and spatialized to support the main voiceovers. The major recordings are from the paper flipping, crumbling, and waving in space. A large room tone with reverberation and amplified water dripping sound are used to generate a fantasy space. Some of the audio instruments and signal processing techniques use Ringz filters, Granular synthesis, and Tendency masks (a stochastic process for creating random values over time).

The processed audio files are rendered individually and layered together in "Reaper," which is a digital audio workstation. The ambient audio clips are rendered by composing various different audio textures as well as field recordings. Although the audio system is capable of real-time processing, these pre-rendered files were used to simplify the installation environment and ensure robust performance for the duration of the exhibition.

Aside from recorded and processed punching sounds, the sounds of the real punching machines had to be considered in the installation. Many experiments were conducted testing different types of equipment for punching. The voltage applied to the solenoids went through several revisions as we tried making the puncher louder and then eventually decided softer was better. The voltage applied to the

stepper motors also had to be tweaked to tweak volume of the punching head as it moved back and forth.

For the most part, the punching sounds are fairly monotonous. In order to give the punching machine some gesture, music analysis techniques are employed in Chapter 2 to synchronize the puncher with the spoken word of the narrator. An onset detector is applied in real-time to the audio to detect the beginning of a sound and output a control-rate trigger signal. In practice, this causes the punching machine to fire an event at the beginning of a word or sequence of words. Events may be a punch, release, or movement of the punching head. Based on the Chapter 2 narration, the punching mechanism fires an event 2 or 3 times on each sentence. This technique creates a sense of urgency, and a dynamic which make the scene stand out.

In cinema, voice narration evokes intimacy yet at the same time a strange flowing energy. The voice is very hard to pin down and tie to its emitter. As Michel Chion notes,

The voice is elusive. Once you've eliminated everything that is not the voice itself—the body that houses it, the words it carries, the notes it sings, the traits by which it defines a speaking person, and the timbres that color it, what's left? What a strange object, what grist for poetic outpourings...[8]

In the book *The Voice in Cinema*, Chion focuses on the uncanny phenomena of the voice in cinema. He describes the voice as a being which hovers over images inside and outside, and seeks a place to settle. This acousmatic presence of a voice which has yet to be connected to a face, he calls an *acousmètre*. An *Acousmètre* is a specific kind of voice-character within cinema which is associated with a mystical power. The disembodied voice seems to come from everywhere. Therefore it has no clearly defined limits to its power. For example, the Hal character in *2001: A Space Odyssey* (1968) by Stanley Kubrick, Alpha 60 in *Alphaville* (1965) by Jean-Luc Godard, and The Wizard of Oz in the *The Wizard of Oz* (1939).

Looking inside the history of cinema, Chion pointed out how the audiences are trained to connect images and sound even though the gap in between the two is as big as ever. The gap between sound and image is still an interesting subject in the media culture. One of the unique characteristics of an *Acousmètre* is the disjunction between sound and image. By supplying the voice, the image is occupied, but the true source of voice's identity is withheld. The gap between the disembodied voice and video images in *Two Women* is very large. The audience needs to use their own imagination to bridge the gap and experience the voice.

Feedback/Reflections

This section will mainly discuss feedback from the opening show at *Currents: The Santa Fe International New Media Art Festival*, Santa Fe, in 2015. The opening night was really packed and over 7000 visitors came to the show.

Audiences were curious about the machines and projections, and gave many compliments. A minority of the audience, confronted with the disturbing news stories and the description of the project, expressed horror or disgust and left immediately. On the other hand, many viewers stayed around reading the news archives and experiencing the piece through multiple iterations. Several viewers confessed to their own losses to suicide, though almost all were reluctant to admit it until they had a lengthy conversation with us.

Some technical suggestions and improvements were suggested. The punching mechanism is very hard to see in the low light. Though the subtitle projection spills over some light, it would be better to install some directed light to show the lines of the punched Morse code. Painting the machine bodies was recommended. The unpainted wood was too light in color compared to the rest of the installation, and the color of the wooden platforms needed to be toned down. The English side of platform gets too crowded since it is the only means to understand the narrator and the news archives. Placement of the subtitles may need to be reconsidered. Use of an English voice over may also be considered.

Lastly, feedback from colleagues and faculty raised concerns about the use of the space. All elements of the piece could be dispersed spatially. The density of the project is too difficult to comprehend at once. Also, the spent rolls of punched paper roll need to be displayed in the space in order to complete the artwork.

Conclusion

Two Women ended up being radically different than how it was originally conceptualized. Over three years of effort, research, experimentation, challenge, collaboration, and execution, *Two Women* was polished and realized. The process was as crucially important as the final result.

Due to the overall complexity of the piece, the learning curve was steep, challenging, and difficult. Handling complex logistics, constantly negotiating with material and system design, and communicating with many different field artists was certainly a great opportunity to gain new skill sets. Through the production of the piece, an enormous set of resources, material, and skill sets were surfaced for the generation of future projects.

The research conducted for the production of *Two Women* benefited enormously from a body of prior artwork, writing, and thinking. The piece was not generated spontaneously. However, the synthesis of the varied disciplines and the numerous experiments conducted along the way hopefully add to the state of the art in some meaningful way.



Fig 12: Photo documentation of the exhibition at Currents: The Santa Fe International New Media Art Festival, Santa Fe, NM on June 10, 2015.

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Biographies

Ha Na Lee was born in Seoul, South Korea. She works primarily in the mediums of video, new media, installation art, and experimental film. Her artwork focuses on portraying an individual's experience of psychological and physical trauma in a poetic narrative. She is especially interested in exploring these themes by creating embodied cinematic experiences and spatializing fragmented narratives in the

form of interactive and immersive environments. Lee earned a Ph.D. from the University of Washington's Center for Digital Arts and Experimental Media (DXARTS). She will join the Film and Media Arts Department at the University of Utah as an Assistant Professor in 2018.

James Hughes was born in Houston, Texas. He is an interdisciplinary artist concerned with systems, agency, and information. James' research involves the use of real-time audio/video processing, audio/video synthesis, computer vision, sensors, networks, robotics and artificial intelligence to create interactive installations and performance platforms.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Clinton and Sanders Looking at the World and Naming Things for the First Time

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Abstract

This artist talk focuses on a short video which I produced and directed in the past year. In the video, I re-edited a CNN debate which took place in 2016 between the democratic presidential candidates. The candidates' speeches are cut apart into words and paired with alternative, self-shot footage. The words, carved out of the tightly crafted speeches, are used to describe natural phenomena, plants and animals. Taken out of their original context, the candidates' voices sound robotic and machine-like. The debate turns into a Rorschach test, onto which viewers can project their own thoughts and associations.

How does the Rorschach test work? The first part of the talk will answer this question, while discussing DeepDream, a machine learning technology developed to recognize and classify visual patterns. I will discuss how an unintentional glitch in the software changed the way it perceives patterns, and how this influenced ideas in my video, for example, political perception as a glitch.

The second part of the talk will then analyze one of the frames of the video. The mise en scène in the frame raises the question: Are there moments in which we perceive reality from the outside of ourselves, as external to our senses? Through this question, I will revisit Plato's *Theory of the Forms*, which is a second influence on the film.

Keywords

Media art, politics, perception, language

Clinton and Sanders Looking at the World And Naming Things for the First Time

Take a look at today's newspaper. The front page features a photo, and this photo is covered with headlines and captions. In an exceedingly screen-based culture, images and text merge together into a single syntax. How does this merging influence our cognitive and political perception, our distinction between what is virtual and what is real, history and fiction? Is language still capable of containing meaning?

This presentation will focus on a short video which I filmed and edited last year. The video analyzes the influence of visual language on cognitive and political perception, using borrowed footage from the 2016 election campaign.

Screen video: *Clinton and Sanders Looking at the World and Naming Things for the First Time* (11:30 minutes)

In the video *Clinton and Sanders Looking at the World and Naming Things for the First Time*, I re-edited a CNN debate which took place in 2016 between the democratic presidential candidates. Their speeches are cut apart into individual words and paired with alternative, self-shot footage. The words of the candidates, carved out of the crafted speeches, now describe plants, animals and natural phenomena. The candidates' voices have a robotic, machine-like affect. The debate turns into a Rorschach test, onto which the viewers can project their own thoughts and associations.

This digital Rorschach test was influenced by the learning process of DeepDream, a machine-learning technology developed by Google in 2014. DeepDream grew out of a prior learning algorithm, and its predecessor was trained to recognize and classify visual patterns. The programmer trained its predecessor by presenting it with an image (for example — of a dog) and naming it “dog” (figure 1). The process was repeated with different images of dogs (figure 2). After many iterations, the predecessor learned to detect and name the dogs in the images by itself (figure 3). Once the predecessor algorithm had reached a state of maturity, the engineers then took the tool and inverted it — giving rise to a new algorithm. Instead of having the algorithm decides if an image is a dog, the engineers asked the algorithm to find the dog in the image. Instead of machine classification, this was termed machine dreaming, hence the name “Deep Dream”. The programmers presented the software with an image devoid of dogs, for example an image of clouds, and asked it to find the dog in the image. DeepDream started imagining dog faces in the clouds, at first swirling colors and then little black noses. This condition, when it occurs in humans, is called pareidolia — a psychological phenomenon in which the

mind perceives familiar patterns where they don't exist (figure 4,5,6). What is novel about DeepDream is that it generates images and in that sense has an imagination. Its creative activity is rooted in its prior knowledge, acquired while it was learning to do a different task, and in that sense this by product might be called the dreaming of a machine.

The brain's tendency to look for meaning and patterns is stronger when there is a feeling of a lack of control—for example, at times of political change and uncertainty. We would speculate that DeepDream is no less in control now than it was before the election. Are we, like DeepDream, trapped in mind patterns that prevent us from perceiving reality as it is? What would it mean to see the world freed from the patterns we've acquired while trying to accomplish a different task? What would it mean to dream and see the world anew? What would it mean to dream with different images than the ones we've already learned?

The video raises these questions. Paradoxically, it does so using imagery that appears generic and familiar, like stock footage. The artist attempts to dream with images that we have not already learned, but the artist can only use images that we have already learned — in my case, from the internet. It is the pairing of the images with the words of the presidential candidates that creates an unlearning of the familiar images and opens a new way of imagining what they could mean.

In the time I have left, I would like to go back to the video and discuss one particular frame. I filmed this frame with the idea in mind that it will be the ending scene of the film. However, halfway through the editing I decided to add another scene after it. In this frame we see a window, and in the window there is a monitor. The monitor shows the missing footage from the debate which we had been listening to— the image of Clinton and Sanders (figure 7). In an ironic twist, the characters look at themselves from the outside, perhaps in a similar way to how we see ourselves in our own dreams. Our gaze from the outside in brings to a climax the gap between reality and perception, which we have been experiencing throughout the video. We can never see reality, but only perceive it subjectively through the senses. This frame asks the question— could there be moments in which we do perceive reality from the outside, as external to our senses?

Plato posed this question in his Theory of the Forms, in which he counterposed the world of substance and how it is presented to our senses, with an external parallel world of forms, which are eternal and changeless, referred to as Ideas. Ideas can be more real than the objects in our world. Forms are singular, whereas things in the world of senses are their plural imitations. There are many dogs in the world, but only one Idea of a Dog. Forms can represent any phenomena in the world: objects, plants and animals, as well as abstract ideas. Plato believed that intelligence is the ability to grasp the world of Forms with one's mind, in spite of living in the world of substance. Through exposure to the many images of dogs, DeepDream perhaps learned to identify the singular, the Idea of a Dog. DeepDream is

derived from something which possessed a semblance of Intelligence. Perhaps this is why it is capable of something which might resemble creative activity, for Plato.

Let's go back to the image of the window, which references the Allegory of the Cave. At this moment in the video, we see the characters, Sanders and Clinton, sit with their backs to the opening of the cave. In this version, perhaps the shadows are not cast on the wall from the light of red flame, but from the blue-light of LCD screens. As in the Allegory, it is open ended where the laptops go — in front of the people (with the screens facing them), or emitting light behind their backs. Is the perspective of the video the perspective of the redeemed, unchained people who are capable of seeing the light of day? The answer depends on what we perceive the shadows to be.

Image list



Fig.01



Fig.02



Fig. 03

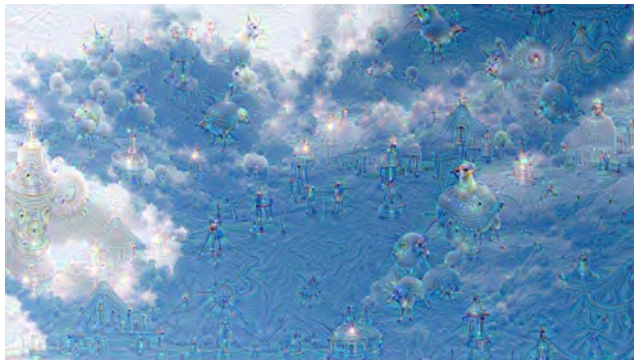


Fig. 04



Fig. 05



Fig. 06



Fig. 07

Image Credits

Fig. 01: Shutterstock

Fig. 02: Shutterstock

Fig. 03: Source: Google Images

Fig. 04: Source: Google Deep Dream Generator

Fig. 05: Source: Google Deep Dream Generator. Image credit: Thorne Brandt – <https://twitter.com/thornebrandt/status/617173618238332928?lang=en>

Fig. 06: Source: Deep Dream Generator. Image credit: Eric Cheng – https://www.youtube.com/channel/UC_lej5HespyRb-AQbasz92A

Fig. 07: *Clinton and Sanders Looking at the World and Naming Things From the First Time* (2017). Image credit: Orr Menirom

Author Biography

Orr Menirom is a Brooklyn based media artist. She is a recipient of a Research Fellowship from Jan Van Eyck Academy (2017) and a former artist in residence at the Skowhegan School of Painting and Sculpture (2016). She holds an MFA from the Film, Video, New Media and Animation Department at the School of the Art Institute of Chicago (IL) and a BFA from Bezalel Academy of Arts and Design (Jerusalem, Israel). Her work has shown internationally at venues such as the Tel-Aviv Museum of Art, International Film Festival Rotterdam, RIXC Center for New Media Culture and Expo Chicago.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Action Coding: Coding as a Calisthenic Practice

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Abstract

Action Coding is an exploration of computer coding as an embodied performance. This paper presents details of the custom gesture recognition system created, the development process of the project, and the after three phases of development.

Keywords

Gesture recognition, performance, motion capture, Kinect, machine learning

Introduction

“Coding is often done in a solitary setting. We sit and think alone, write, revise, possibly submit for code review, revise again, and then merge.”[1]

—Emil Ong, a computer coder writing for *Hackernoon*, on Medium.com

“‘Coding’ is not a musical art, a piano or a violin that a child might need to develop muscle-memory for. It’s engineering.”[2]

—Attila Vágó, a computer coder writing for *Hackernoon* on Medium.com

These two passages express the underlying reality and culture of computer programming, also known as coding. There is a heroism, a machismo, and an exclusivity implied in these conceptions of coding. The coder, cast in mental battle with his machine, spends hours formulating and typing the perfect chain of commands to build a script that executes without error.

Likewise this image of the coder brings to mind a typical setting: a(n often) male and predominantly white hunched over a computer at a table or desk, perfectly still while his across the keyboard, hours passing without notice.

This was not always the case. Women, the computers and computer operators, because of their attention to detail and high threshold for the drudgery of calculations. In performing calculations for rocket trajectories during World War II, women were also the programmers of the general purpose electronic computers, because at the time computation and software was not considered ‘men’s work’: circuitry and hardware were. Women also performed the highly physical labor of unplugging and replugging cables of Colussus machines during World War II. However, as digital technologies have become more centralized and prevalent in daily life, so has its culture become more mainstreamed, co-opted and controlled by majority culture: educated white men. Though this reality is slowly changing thanks to Girls Who Code and other initiatives, the dominant culture of coding is still described in media headlines as ‘Bro Culture’ shaped and controlled by white upperclass men.

Coding culture holds as a central tenet that coding is hard—it is an exclusive club for the strong-willed.

by the tech industry’s central focus on of speed and process (and thus historic developments in hardware and software have attended to the increasing speed. Successful coders pride themselves on speed, accuracy, and endurance, and text entry via keyboard is the standard for code because of its speed and reliability. Vágó continues, “What programming requires is analytical thinking, problem-solving attitude, stamina for failed attempts at coming up with the right solution, passion for technology, pride in your own code, but maturely accepting someone else’s im-

provements and observations, and a sense of responsibility for any code you write or contribute to. Correct me if I am wrong, but none of these traits are easy to cultivate and develop.”[3]

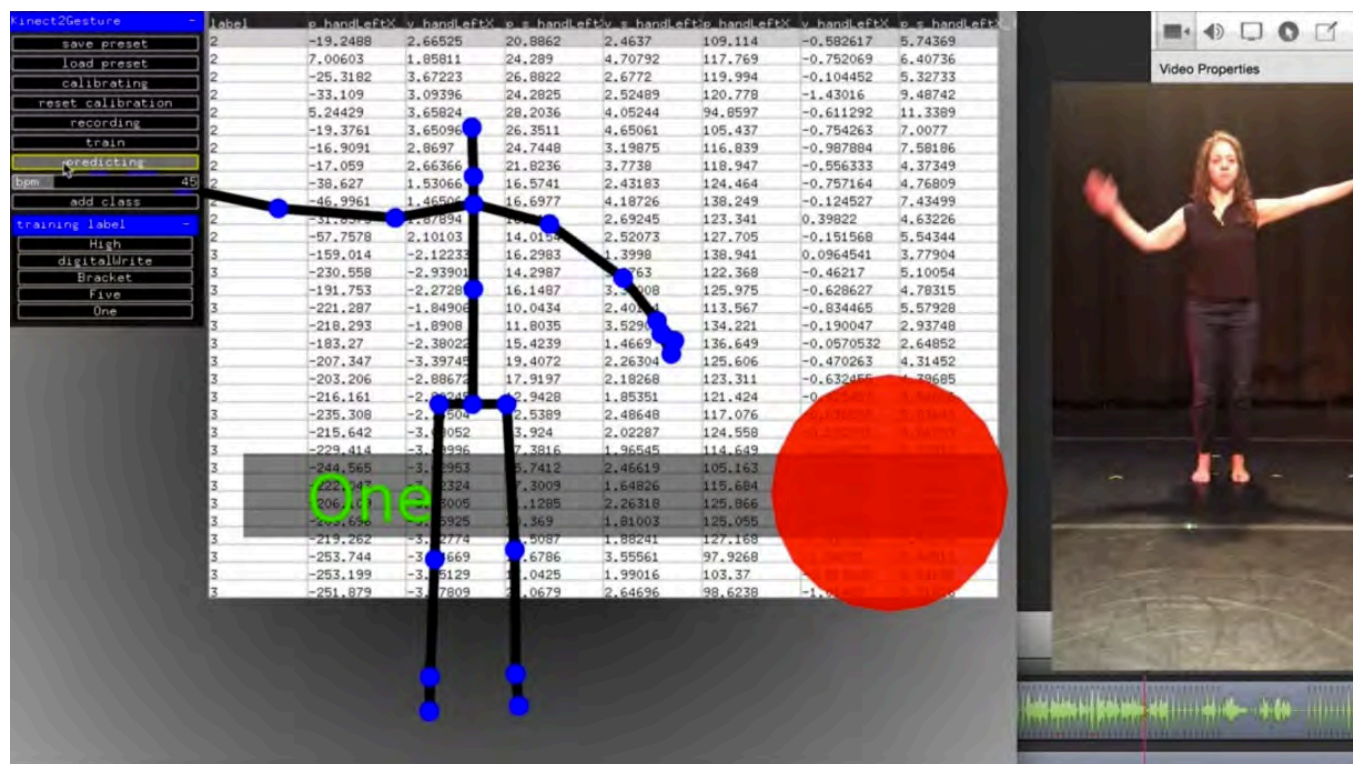
To arrive at that point of cultivation, a coding language requires multiple forms of literacies, knowledge, and access: the ability to read, a basic understanding of how computers work, consistent access to computer hardware and software, access to a learning environment (a physical classroom, an online course). Coding is traditionally taught in classrooms with a 1:1 student-to-computer ratio. Students are introduced to syntax through introductory scripts. Pedagogy, arising from coding’s roots in mathematics relies singularly on interior cognition skills—a silent process of problem-solving in the mind. Learning processes privilege and empower the machine: students, from their earliest moments with code, are against error messages, un-executable scripts and all their attendant failures. Reports of beginning coding classes have used words like ‘punishing’, ‘painful’, and ‘awful’. the image of the lone hero, students must suffer alone, battling against their machine.

Likewise, the environment and conditions within which coding is performed reproduces itself within the products of code. Coding is a seated affair that only employs the -gertips. Software, apps and other digital products are also intended to be used most often while seated, still, and em-

playing only the This feedback loop reinforces the of the lone hero (more often than not male), engaged in solitary activity with his digital device. This condition parallels gender differences in the way men and women work. Men prefer to work alone, women in groups.[4] And perhaps this is one of the contributing factors to the gender gap in tech companies.

Lastly, the ever-expanding reach of digital technologies—under the guise of ease and the ever decreasing use of the body. Since the industrial revolution, industrial processes, automation, home appliances, and now digital applications and services, have outsourced the work of the body. When compared to these automated and digital options, the body is circumvented because of its lack of speed and . Outsourcing so much work from the body to other machines and services has an impact. The cultures served by these systems resultantly are in physical crisis. The rise of obesity, depression, and the series of other physical effects of inactivity have been correlated to the increase of prevalence of digital technologies. [5]

These realities construct a space that is highly gendered, exclusive, and alienating whose long-term effects can also cause physical damage to the body. In response *Action Coding* is an attempt to create a space for learning code that is physical, cooperative and visible. What if code were approached as an externalized, performed activity such as dance or sport? Could code therefore be learned coopera-



Kinect2Gesture tutorial window shows the application interface that includes the coder’s tracked skeleton and red time-keeping circle on the left, while Morgan Hille-Refakis performs the gesture on the right.

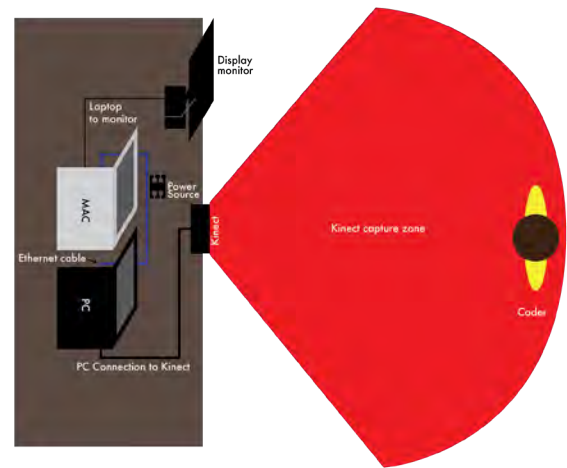
tively, by watching and repeating through the body? If coding is a visible and cooperatively learned, physical experience, what access is afforded? Who gravitates towards this physical process? How does the physical and mental experience differ from the traditional experience of coding? How does the experience and understanding of code change? And more abstractly, what might the products of coding become if performed in this way?

Action Coding: re-establishing the physical and cognitive of coding

Action Coding, a series of collaborative investigations, is an initial inquiry into alternate methods of performing code with the body—one that, in opposition to Vágó's introductory quote—approaches coding through muscle memory, and asserts a potential relationship between engineering and the body. Over the course of eighteen months, I had the honor of collaborating with a series of talented creative technologists Gene Kogan, David Sheinkopf, Ramsey Nasser, technologist and dancer Caitlin Sikora, and dancer/choreographer Morgan Hille-Refakis. Together we explored the connections between body and machine, making coding more performative—more visible, tangible, physically strenuous and embodied. The goals of the project are to activate multiple learning senses simultaneously, increase use of the body, and to shift coding to a visible performance that may be learned by watching. [6]

If learning to code is an individual, interiorized process, learning a dance, a sport, or even sign language is cooperative and collective. The cultures of dance, sport, and exercise are based on physical demonstration, and repetition, and cooperative dialogue around technique and skill. Learning dance activates sight, proprioception, balance, and the full neuromuscular system to see and translate movements through the body. The mind and the body work together to process and express movement patterns.

In *Action Coding*, a 'coder' stands in front of a Kinect. On a large display next to the Kinect, she can see a skeleton version of herself, a big red circle that turns on and off like a metronome, and in another, the window of a coding environment (such as Arduino). Every time the red dot appears (along with a clicking metronome sound), she performs the gesture corresponding to the piece of code she is writing. This could be a command or variable or other necessary syntax. She must complete the entire gesture before the red circle disappears. When it does, the computer has interpreted her gesture and assigned it a class of its library. Simultaneously, the class appears in the coding environment in the adjacent window. Gesture by gesture she builds a script. Depending on the environment, she may have her script or 'Execute' gesture.



Action Coding system diagram

Building a system where none exists

Substituting the body for keyboard necessitated creating a new kind of gesture recognition system. Because no pre-made system existed to achieve the goals of the project, one was bricolaged from available technologies and augmented by custom applications. Built with the goal of at-home/consumer access, the Kinect was chosen to capture gestural data, and the system was built around it. More expensive and advanced motion capture hardware systems were rejected for their lack of access and availability beyond professional or academic settings. To employ the Kinect in this way, Gene Kogan conceived and wrote Kinect2Gesture, a custom machine learning application. In addition to the Kinect and PC laptop through which to run it, and Kinect2Gesture, the system required a second laptop and ethernet cable (or strong connection) through which to transmit data, and a large monitor on which the performer can see the Kinect2Gesture and their coding environment. The Kinect/PC transmits data via OSC to another laptop (we used a Mac) running Kinect2Gesture, which translates the data into a gesture prediction, then inputs that data into the chosen coding environment (in the case of this project, Arduino, p5.js, and BodyLang).

Kinect2Gesture is a free and open source application which uses a neural network to automatically classify, in real-time, the physical motions of the full-body coder who is being tracked by the Kinect's infrared camera. When the coder performs a gesture that has been associated with a particular class or follow-up action the application sends the decisions over a network to other computers or applications which act upon the data, for example an Arduino or audiovisual software like MaxMSP, simultaneous to the performance. This has the effect of augmenting the dancer's movements across multiple modes and media.

Kinect2Gesture differs from other full-body gestural

systems in that it uses machine learning algorithms in the creation of gesture libraries. Users may devise a series of gestures and train the computer to recognize any single gesture performed within a pre-set time-frame set by the user in Kinect2Gesture to the start and end parameters of the movement.

To train the system in a new gesture, the gesture must be performed repeatedly (20-60 times). Each repeated performance generates a data. In running the 'Train' function in Kinect2Gesture, the machine parses all 20-60 data sets for each gesture 'learning' the physical of each class entered into its library (stored as a linked XML). The wider the variation in subtleties of the movement in style and speed during the training process, the greater the prediction accuracy. Not only can users their own gesture libraries, they can also apply those libraries to a variety of coding environments. As an application, Kinect2Gesture is not constrained to any particular development environment, nor is anyone who might want to engage with Kinect2Gesture in this manner be constrained to a limited library of pre-made gestures.

Once the system has been trained on the series of gestures corresponding to the necessary commands and inputs of a coding syntax, 'Prediction' mode is selected. In Prediction mode, Kinect2Gesture compares Kinect data to the spectrum of data sets it has learned for each gesture and predicts the gesture that has been performed. In order to capture a usable data set, the application uses a visual metronome in the form of a large red dot that signals to the coder when the system is 'watching' and thus the window within which she needs to perform the gesture in full. The prediction is output on screen immediately, and that data is input into the

selected coding environment.

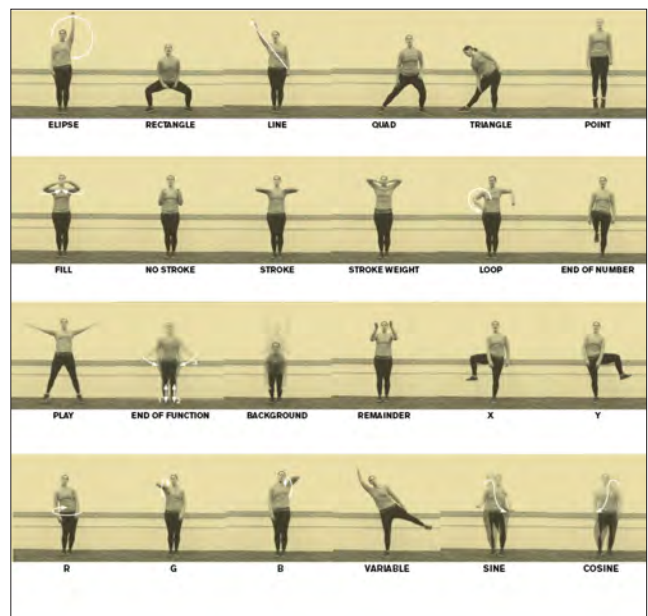
Learning by doing: an iterative process in three phases

Action Coding consisted of three distinct research phases. The phase, in collaboration with Gene Kogan, David Sheinkopf and Morgan Hille-Refakis, tested the initial intention of the project by building a small gesture library that could be used to write Arduino scripts to turn LED lights on and off. An additional considerations of this phase focused on the body. To shift the labor of writing of code from the and keyboard to the full body, a series of considerations for the health and wellness of the body formed parameters for gesture creation and performance. To avoid fatigue and/or repetitive stress of a particular joint or limb gestures should engage the full body, from head to toe; and gestures should be balanced across the body in lateral, frontal and sagittal planes. Secondly the goals to create gestures that were meaningful, memorable and pleasurable guided the project. 'Meaningful' gestures concerned connecting the semiotics of the movement with code semantics. 'Memorable' gestures combined meaning with variety and unique body positions. 'Pleasurable' gestures were those as fun to perform and repeat.

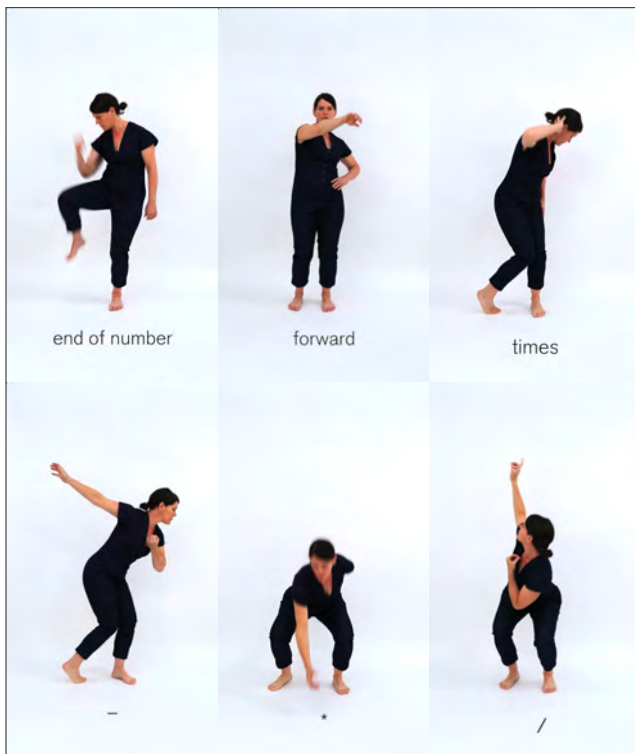
We began by working with a series of three scripts: to turn a light on, to make a light blink rapidly, and to slow the blinking down and turn the light off, and worked with two other dancers, Carlo Antonio Villaneuva, and Morgan Preston, neither of whom had prior coding experience. Each script was deconstructed into necessary functions and inputs, for which a gestural 'dictionary' was created. This dic-



Morgan Hille-Refakis performs components of the Arduino gesture 'dictionary'.



Segment of p5.js dictionary, performed by Nancy Nowacek.

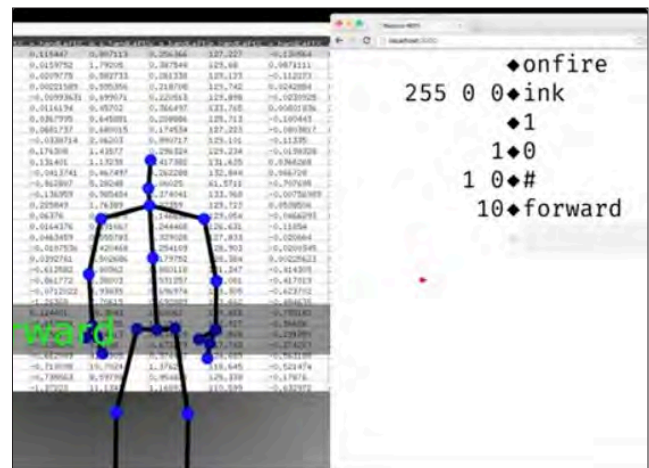


Segment of BodyLang dictionary, performed by Nancy Nowacek.

tionary included gestures for the full set of commands and syntax necessary to write each script such as ‘VoidSetup’ and syntax such as the semicolon. We realized that in this test phase, the code performer was simply ‘performing typing’ with the whole body, so the goal of the second phase was to create gestures for full functions.

This phase of the project was realized in three public presentations, two in dance performance contexts—the Your Move festival, and Movement Research Spring program at Judson Church, as well as an exhibition context as a participatory project.

Motivated by the observed potential of the gestural input system to correlate with graphic focus of p5.js, technologist and dancer Caitlin Sikora and I, with Morgan Hille-Refakis, developed a second library of gestures. Building on experiences from the Arduino ‘dictionary’, our goal was to seek a more direct relationship between gesture, meaning, and operational function. Two sample scripts—one to draw a circle and the other to draw a series of vertical lines to create a square—were our basis for dictionary creation. Based on learning from the phase, this phase increased the envelope of movement and number of entries in the dictionary. Single gestures in this library were created to communicate functions such as ‘stroke weight’ and ‘end of function’ in addition to ‘ellipse’ ‘rectangle’ ‘line’ and numbers 0-9 and involved different forms of jumps, squats, and directional arm movements, amongst others. This phase moved further



Monitor display for BodyLang: minimized Kinect2Gesture window on the left, BodyLang code in progress on the right.

away from performing typing, though still directly related to the syntax of p5.

For example, the command to draw a circle was performed by moving the right arm in a large circle. The command to draw a rectangle was represented by a lower body shape, with knees out to each side at 90° angles over ankles, that resembled a rectangle. We built a larger library of gestures with the goal of clustering p5 syntax in meaningful way, such that a single gesture could correspond to strings of syntax. This phase was presented publicly at The School for Poetic Computation’s spring exhibition as a video work.

In the third phase, a custom language, BodyLang, written by Ramsey Nasser, was employed to create the most direct connection between gesture and code. Based on Logo, BodyLang is stack language for drawing. Of all three iterations of the project, the nature of Nasser’s stack language allows the most direct connection between gesture and code. As new lines are added to the stack, the code executes in real time without need to compile, upload, or play. This supplies instant feedback to the coder, and supports improvisation and play with the system more so than the other environments. The goal of this phase was to ‘perform code’ in its most elegant sense, moving as far from the ‘performing typing’ paradigm as possible. Additionally, the goal of the gestural language of it’s dictionary was an experiment shifted the sense ‘meaningful’ in the previous sense, to ‘being recognizable’ and intensifying ‘memorable’ and ‘pleasurable’ by using vernacular gestures from sports and hip hop cultures. Gestures were inspired by basketball, football, and music videos. The “free-throw”, the “end-zone slam,” and the “stank leg” represented commands such as pen-up, end of number, and repeated cycles. This phase of project development was presented publicly alongside the two phases in a solo art exhibition at Eyebeam (“Easy Is Not A Concept”), a public workshop, and a college class workshop at Scripps College—a women’s college.

Limits and potentials

Findings can be separated into four categories: the limitations of the Kinect, the limitations of the system, the limitations of the coder, and the potentials of the system.

Much time was spent exploring the spectrum of movement within the Kinect's capabilities. Crossing limbs, spins, or shifts in head and hip position were not readily detectable by the Kinect. Therefore, gestures were constrained to the frontal plane and focused on the shapes produced by the body, with focus on the arms and legs. Often gestures needed revising because they were too subtle to be detected. The resulting learning is a correlation between Kinect vision and cheerleading: the bigger the shape created by the body, and the more crisp its execution, the more clearly it could be consistently perceived.

The Kinect's data capture impacted the rest of the system. Though all gestures were devised to be as visually unique as possible to enable successful prediction—especially with regard to gestures that may be used consecutively such as numbers—the data captured by the Kinect and used by Kinect2Gesture often resulted in prediction errors. Each code library contained no more than 30 entries, which was considered to be a very small and symbolic amount by the team. However, it became clear that the maximum number of discreet detectable gestures, within this system, could be no more than 5-10.

Furthermore, the system's complexity also limited its success. Each component of the system—Kinect, PC, Mac, wireless communication and other peripherals—introduced potential failure points and factors that could be accounted for but not easily addressed.

When the system was performing at its best and fully functioning, the results the original intent of the project. Participants reported that they felt like they were playing a game: trying to perform the correct gesture in the correct sequence was fun, exciting, and engaging. Participating dancers commented that performing coding gestures in collaboration with the system also felt like 'performing good technique', and that seeking the best expression of each gesture was a stimulating challenge much like performing a proper grand plié.

Participating dancers who had no prior experience with computer coding, reported that they were able to connect to the code through movement. Memorizing the choreography of a particular script, in effect taught each dancer the basics of the code. Embodied experience of a script built muscle memory but also repeated movement patterns created a sense of what should 'naturally' come next. Once dancers learned scripts, they were able to manipulate and iterate the code because they also had built an operational sense of the code through their bodies.

Project participants given the choice of which dictionary to learn most often gravitated to the BodyLang dictionary. Participants seem to gravitate towards these movements

because they seem more 'familiar' and 'fun' and 'dance-y' than those used in P5 and Arduino which seem more 'basic' and 'like exercise'.

No matter the physical training or coordination in participant, limitations of the body were observed. Participants shared feelings of panic and confusion when attempting to perform gestures in time with the Kinect2Gesture's rate of capture. Though that rate can be set by the user to any beats per minute, the factor of time for new participants create a pressure that short-circuited the mind-body connection. Because the body and mind are so rarely employed in simultaneous labor such as this, the performer's system can be easily overwhelmed by the dual process of recalling a gesture and performing it to a set beat per minute. However, when scripts are learned and memorized they can more easily—and pleasurably—be performed in collaboration with the system resulted in two developments. The

is awareness of the need to introduce participants to the gestural languages followed by memorizing a beginning sample script completely before engaging the system online. Secondly, once a basic script has been memorized, it can be more easily expanded upon or manipulated by the coder. The 'processing load' when working simultaneously in the mind and body impacted advanced users as well. For more advanced users capable of improvising and coding on the , there was a repeated and consistent need to pause the system in order to compile the next string of inputs in the brain before performing them in time to the system's beat. Gestures for 'pause' and 'resume' were added to the BodyLang library.

Lastly, a consistent observation throughout the project was general body fatigue after a couple hours' work with the system. Likewise, a brain fatigue was also observed in conjunction with the tired body, where the ability to recall or correctly perform a gesture began to decrease over long stretches of time. This fatigue was not perceived as negative, however. Often the phrase 'a good tired' was employed to describe the fatigue, accompanying reports of an overall sense of satisfaction from have the feeling of [bodily] accomplishment.

Conclusions and future work

In the context of *Action Coding*, a visible series of full-body actions aids in the formation of the building blocks of coding: the mind learns through the body. Syntax becomes a swing of an arm, a jump, or a squat; and logic becomes repeated movement patterns and pairs, much like dance.

If coding becomes visible, tangible, embodied, and co-operative, who feels invited to code? The participants most drawn to the project in public presentations were female. Many interested participants approached the project because they studied dance at one point, or were still practicing dance. Others gravitated towards the project because

of the unique quality of the movements and interest in the visible interaction with the Kinect.

One of *Action Coding*'s most important achievements is a system in which anyone can create a series of full-body gestures and train the system on them. This capability offers a wide variety of users with a spectrum of mobility capacities to participate in motion capture and gesture recognition technologies. For example, a user who sits in a wheelchair or who cannot stand for long periods of time can create a library using only the upper body.

If coding is a physical process, how is learning code impacted? The introduction to coding through an embodied process was shown to be a very powerful for those new to coding. Working with beginning coders through physical movements, and then applying those movements to a gesture recognition system such as *Action Coding* could be a very powerful new paradigm for teaching code. The procedural memory required by the physical process amplifies the procedural memory required by computer coding; and the motor programs acquired by this process underscore the computational programs of code. In this way, the project reimagines coding as a function, in part, of motor learning; a new 'coder' may learn and internalize syntax and logic patterns more quickly and because they are taken in through the full neuromuscular system, retain them longer [7,8,9]. As artistic research it suggests a pedagogy of experimentation, fun and one driven by iteration, not failure.

And more abstractly, what might the products of coding become if performed in this way? No conclusions towards products have surfaced, however, the positive effects of working with code in a physical, cooperative, embodied manner challenge dominant capital-driven notions of . Coding through this system is admittedly not it is . However, the affective outcomes of the project are robust: participants who normally spend the bulk of their work and recreational time on computers reported feeling tired but good. To reiterate, they felt a feeling of accomplishment and achievement. These outcomes suggest an economic ecology that includes wellness ganizational goals.

Future work in this domain will continue, and seek larger groups of participants from multiple ages, racial and ethnic backgrounds, and abilities. Future iterations will start by seeking to revisit the gesture recognition system components in hopes of the motion capture capabilities and reducing the complexity and opportunity for error. Investigation will continue around gesture, semiotics, and syntax.

The objective of *Action Coding*—as a research-based art project—was not to revolutionize digital industries, it suggests modes of cooperation and human-machine interaction that could employed address it's historic culture and diversity problems by inviting new groups of coders to learn and use code in untold of new ways.

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Author Biography

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Nowacek is currently a research resident with Cape Cod National Seashore and Freshkills Park (Freshkills R&D). She was previously a fellow at Eyebeam, and has previously been supported by residencies through the Lower Manhattan Cultural Council, Recess, Signal Fire and the Sharpe Walentas Studio Program. She teaches art and design at the Stevens Institute of Technology, and organizes exhibitions, panels and events devoted to waterways and climate change as well as bodies and technology. She has presented works in New York, Los Angeles and the Bay Area, Canada, South America and Europe.

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INTERSECTIONS

Elemental Monitoring: The Afterlife of a Breath

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Abstract

Within the growing nexus of computational and environmental information, elemental media such as the wind now exists *in vivo*, *in vitro* and *in silico*. Observing these elements through the tools and methods of environmental monitoring, this paper describes a systematic progression of wind and breath as an elemental force from embodied to disembodied to digital forms, considering the scales of experience of these as organic, as well as transcendent digital objects. It also touches on alternative systems of belief that view the wind as a spiritual or transcendental repository of sound and voice. This diversifies the practice of environmental monitoring to incorporate the cultural sensitivities of literary and artistic sources both historical and current, in order to find new ways to articulate data meaningfully and experientially. The paper also describes a project by the author that uses wind data as a catalyst for the imagination. In this way, the practice of data visualization cannot simply be seen as the “anti-sublime”, but instead, as an attempt to render the measured data as an immeasurable part of the artistic system.

Keywords

Aeolian, elemental media, immeasurable, information

Introduction

“While exhaled air usually vanishes without a trace, the breath encased in these orbs is granted a momentary afterlife. While the bubbles move through space, the creator is truly outside himself - with them and in them” Peter Sloterdijk [1]

In Peter Sloterdijk’s description of the soap bubble in flight, the bubble, carried up and out into the open is attentively followed by its creator-observer. He watches as it is steered and tossed about, until it emphatically bursts and both its contents and his focus are thrown into expanded space. Breath that was previously circulated within the body of the creator now inhabits a larger atmospheric space. In Tim Ingold’s words, the body becomes *enwinded* in the process of merging the scales of

personal and global. [2] The creator experiences a “soul expansion”, these mobile orbs becoming spectacles that leave him at his penultimate end in open, boundless space. And beyond this expanse of universal circulation, the breath experiences a transition in base state (a parallel to moving from body to soul) from analog to digital – transforming wind into data bits through environmental sensor networks.

According to the United Nations Office for Outer Space Affairs, there are now over four thousand satellites in orbit today engaged in the processes of observation, monitoring, navigation and communication. [3] Complementing the aerial surveillance are networked, distributed, digital sensors at ground level, these technologies transform the planet into a ‘digital earth’. Sensing technologies, as they become ubiquitous in society, are now indispensable in the development of scientific understanding of environmental and social concerns¹. [4] As well as the potential for increased knowledge about our environments, the data that these technologies offer are often available on open data sources, promoting a myriad of creative engagements with data as raw material.

The practice of environmental monitoring focuses on the interfaces and communicative potential of digital transduction. In proposing the term *elemental* monitoring, I focus not only on the way the elements are transduced but also explore a systematic progression of elemental media from embodied to disembodied to digital forms in order to allow narratives or symbolic metaphors associated with any one form to be considered as cultural value for any other incarnation. Thus, the paper focuses on the wind as a

¹ In Gabrys, p3, she expands on the types of information sensors typically collect - including social and smartphone data for “managing cities and facilitating logistics”.

² The terms soundscape, soundmark, and keynote sounds are all terms proposed to describe the sonic character or identity of any given space. Schafer also advocated good listening habits and

case study for how different cultural perspectives could make sense of the information contained in the environment, acknowledging a developing trend in informative systems where climate phenomena is now being increasingly introduced into our digital topographies as raw material for data visualization and information design practices. The paper also describes the artwork *The Aeolus Notification System* that engages with both real time and metaphorical content of the wind, exploring its creative strategy for a fundamental challenge for artistic systems that use data as raw material –making the immeasurable (data) measurable, in a way that is experientially immeasurable. This artwork, and artistic thought process is part of the author’s artistic research at the intersections of hybrid media and visual and immersive installations

Terra Naturalis / Terra Notitia

Since the dawn of time, man has always looked to the skies in wonder. The expanse of space was an immeasurable void for the natural philosophers; the cosmos an indivisible, infinite symbol of God as well as the spatial container He existed in. [5] The imagination of vastness and infinity forms the philosophical tradition of the sublime, the basis of modern aesthetic theory in the visual and plastic arts. [6] In Kantian aesthetics, the sublime is associated with a feeling of terror at the vast “synthesis of world and self, facts and ideas, images and feelings. [7] Indeed the imagining of the extra-cosmic expanse reveals a paradoxical truth: that we are at once insignificantly small and an integral part of this universe.

Today a different ‘cosmos’ exists as defined by the near-infinite borders of digital technology. Emerging from a mixture of material and immaterial infrastructures, the digital Universe is a large informational habitat that sustains the mobility and agency of advanced human civilisation. Encyclopedic and inscriptive, archival and present, interactive and participatory, this universe comprises of immense number of digital signals generated through the activity of millions of users, running through cables stretched, strung, suspended and submerged across our physical landscapes.

Recent developments in digital environments show some similarities in the ways we think about the digital and the analog – the ‘cloud’ or the ‘ether’ is seen simultaneously as part of the organic world, but also as an invisible hinterland through which content producers share and collaborate on data and data delivery practices. Especially in the advent of digital natives who are likely to experience the world predominantly through some form of digital content, natural environments now amenable to a digital

metaphorization even as they are being transduced through complex sensor networks.

In Katherine Hayles’ *Regime of Computation*, she discusses the way code not only generates metaphors of natural systems, but also presents the opportunity for a ontological view of nature:

“The Regime of Computation, then, provides a narrative that accounts for the evolution of the universe, life, mind and mind reflecting on mind by connecting these emergences with computational processes that operate both in human-created simulations and in the universe understood as software running on a ‘Universal Computer’ we call reality. . . code is understood as the discourse system that mirrors what happens in nature and that generates nature itself.” [8]

This afterlife of a breath is a metaphor for the creation of a new nature in which ‘natural’ entities may live on in their digital incarnations. With a nascent emphasis on data analysis, the systematic practice of transducing data is routinely carried out as a communicative process – resulting in the expectation for art to be both aesthetic and informational. That is how the natural environment is experienced now – both *in vivo* and *in silico*. In moving from a *terra naturalis* (the natural earth) to a *terra notitia* (informational or programmatic earth), we are encouraged to expand our ‘bubble’ of consciousness into both fields, and to consider the ways elemental media can revitalise our digital topographies.

Materializing, Measuring Air

“Air does not show itself. As such, it escapes appearing as a being. It allows itself to be forgotten . . . except in cases where human activity has fabricated the air to begin with.” Luce Irigaray. [9]

“There is a dead space between mouth and lung. It’s the volume of inhaled air that does not take part in gas exchange.” Madhur Anand. [10]

Both wind (in the environment) and breath share a common neglect. These quotidian and often overlooked aspects of everyday life offer profound metaphors for life. It was the natural philosophers of the early Enlightenment who would first contest air as an invisible, forgotten ether and proceed to assiduously identify and catalog a growing array of gases that form the foundation of what we know now to be our atmosphere. Observing cycles of respiration and transpiration and designing experiments to tease out systemic relationships between them, they simultaneously materialized and visualized air through inorganic instruments of the laboratory.

Vacuum pumps, cannisters and tubes compartmentalized and cataloged air as material databases; the air was probed, heated, cooled, inhaled, swallowed and expelled for information. Laboratory experiments were a simulation of life itself - the very breaths of wonder and amazement that witnessed Robert Boyle's vacuum pump spectacles in the late 17th Century could now be seen as liminal and transitory as those that were alternately removed from the lungs of his avian subjects. [11]

Amongst the great prophets of technology, mathematician Charles Babbage was particularly conscious of way the air could be seen as an infinite database. [12] In the *Ninth Bridgewater Treatise* of 1837 he describes how "the air we breathe is the never-failing historian of the sentiments we have uttered", where the atmosphere becomes activated by human conversation, utterances and *all* sound:

"The pulsations of the air, once set in motion by the human voice, cease not to exist with the sounds to which they give rise." [13]

And in adapting this to Nature in Romantic prose:

"No motion impressed by natural causes, or by human agency, is ever obliterated. The ripple on the ocean's surface caused by a gentle breeze, or the still water which marks the more immediate track of a ponderous vessel gliding . . . are equally indelible. The momentary waves raised . . . leave behind them an endless progeny, which . . . will pursue their ceaseless course till ocean be itself annihilated." [14]

In Thoreau's Walden, we see a similar experience of listening to sounds that acquire a sort of immortality in the way they never seem to die but are taken up and 'echoed' by different agents in the woods. Here he describes the experience of listening to the bells from Walden:

"There came to me in this case a melody which the air had strained, and which had conversed with every leaf and needle of the wood, that portion of the sound which the elements had taken up and modulated and echoed from vale to vale. The echo is, to some extent, an original sound, and therein is the magic and charm of it. It is not merely a repetition of what was worth repeating in the bell, but partly the voice of the wood; the same trivial words and notes sung by a wood-nymph." [15]

Here traces of sounds are heard in every part of the forest, animal vocalizations, or echoes through open spaces, are seen as what they are - sympathetic resonances in a vibratory continuum that ferry sonic messages through space.

As in many indigenous traditions, the Bosavi people in Papua New Guinea listen to the wind as voices, or passages of their ancestors through their forests, so much so that their everyday environment becomes as much a landscape of harvest and sustenance, but also one of nostalgic and sentimental engagement. [16] The adage 'voices carried on the wind' here used as an allusion to the ability of wind to contain memory and mythology.

In the same way sound establishes networks of resonance, breath sets the air around us into motion and establishes resonances between humans. In Hebrew, Greek and Latin the words for wind - *ruach*, *pnuema* and *spiritus* respectively have interchangeable meanings between breath, wind and spirit.

Writing about Thoreau's experience at Walden, R. Murray Schafer describes how he experiences "in the sounds and sights of nature an inexhaustible entertainment". [17] In line with the transcendentalist school of thought, Schafer and the Acoustic Ecology movement sought to create a revolution in auditory experience of the environment by "tuning" the ear to the earth's audible wilderness. Merging a rationalist urge to catalog and diagnose a particular soundscape, with an imaginative, transcendent mode of listening to nature, Schafer developed a lexicon of terms² for describing and discussing sounds in the environment that would include both literary prose and narrative anecdotes, but also musical and mathematical bases for sound.

For Thoreau, the wind represents a sort of wilderness in the way it is untamed, not controlled by man or society. His clarion call to experience nature directly through walking or *sauntering* parallels Schafer's practice of the soundwalk in its focus on the embodied and holistic perception of auditory stimulus in the environment. Thoreau's walking functions for him as a politically subversive act. By asserting his freedom in the 'wild', he is able to imagine a 'wilderness' without civil and societal burden. In the opening lines to his chapter on *Walking*, Thoreau writes:

"I wish to speak a word for Nature, for absolute freedom and wildness, as contrasted with a freedom and culture merely civil, - to regard man as an inhabitant, or a part and parcel of Nature, rather than a member of society." [18]

Aeolian instruments today aim to elucidate untapped wildness in Nature by creating a spectacle of ephemeral

² The terms soundscape, soundmark, and keynote sounds are all terms proposed to describe the sonic character or identity of any given space. Schafer also advocated good listening habits and wrote about noise pollution, contrasting high fidelity and low fidelity soundscapes. See Schafer, 1977.

wind and musical civility. In Schafer's descriptions, the wind creates an aural illusion, because "without objects in its path, the wind betrays no apparent movement". [19] The Aeolian harp thus creates a site-specific spectacle in its vocalization of wind *in situ*³.

Today, Aeolian instruments bear multiple shapes and forms and vocalize the winds in myriad ways. In Gordon Monahan's 1984 *Long Aeolian Piano*, exhibited in New Brunswick in 1984, long piano wires are strung through the piano's soundboard and anchored to peg boards at the other end. Oriented perpendicular to the prevailing wind, aeolian tones are thus excited in the strings. [20]

Aeolian Metaphors

For the Romantic poets, observing and writing about the wind was a way to personify it within these metaphors of Nature, breath and spirit. Adding to the keen, poetic observation of the environment by the Romantics and its subsequent representation as an extension of the human emotion, instruments that reveal certain wonders of nature, or showcase surprising complexities and unpredictabilities of nature were particularly referenced and used.

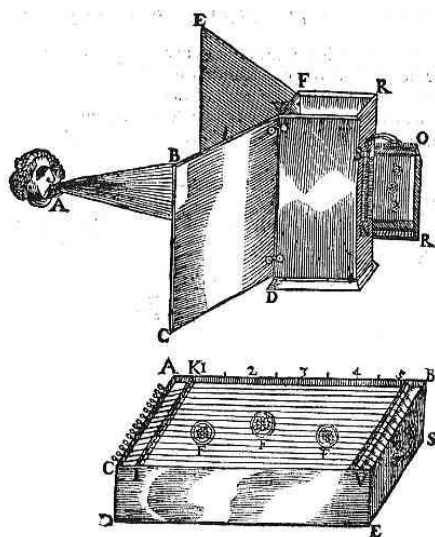


Figure 1. The Aeolian Harp in Athanasius Kircher's *Phonurgia Nova*. [21]

³ While its reference to transcendentalist imaginations of Nature are strong, political metaphors of the Aeolian are not well developed and are worth a measure of further research.

The Aeolian harp was a recurrent theme in the inspiration and imagination of Romantic writers like Shelley, Coleridge, Wordsworth and Melville. Invented by Jesuit priest Athanasius Kircher, the Aeolian harp was one in a series of instruments that Kircher had proposed in his *Musurgia universalis* (1650) and again, in *Phonurgia nova* (1673). [22]

Thomas Hankins provides a physical description and activity of the Aeolian harp:

"The aeolian harp is a stringed instrument played by the wind. The most common form is a rectangular closed box about three feet long, six inches wide and three inches deep. Three to twelve strings, tuned in unison, are stretched the length of the box between two bridges, and one or more sounding holes is cut in the top of the box above the string. The harp sits on a windowsill with the sash drawn down just above the strings. When there is a draft through the window, the harp will sound one or more notes, the pitch depending on the strength of the wind. The music has an eerie quality and is difficult to locate. Very slight changes in the draft will bring on different notes, at first harmonious and indolent, but as the wind strengthens, marked dissonances occur until in a strong wind the music becomes more like a scream. Nothing could better match the sentiment of the romantic soul." [23]

This personification of the wind is seen predominantly in Romantic literature where the Aeolian harp⁴ was not only a physical instrument that was celebrated, but a symbol of the transcendent breath of Nature. Attributing a *voice* to the elements is a vestigial trace of the Romantic fascination with Nature and a desire to communicate with her. The Aeolian harp is distinguished from other wind-driven instruments in that it does not require human agency the way bullroarers, wind wands, or more common orchestral woodwinds and brass wind instruments; instead it "was superior to other instruments because its music was unpredictable and because it was played, not by man, but by the breath of Nature herself". [24]

As its name suggests, the Aeolian harp references Greek Mythology in the character of Aeolus, King of the floating islands of Aeolia and divine keeper of winds in Homer's *Odyssey*. [25] Athanasius Kircher continues his fabrication of the Aeolian harp with the creation of a unique aeolian-human orchestra, in which musical performers could take the stage alongside these harps in

⁴ Musical applications of the aeolian harp are documented within the Western classical tradition, though variations of the harp can be found in Asian influences such as the Cambodian singing kite (khleng ek). More installation based version of the harps are available as sound sculptures from such artists such as Max Eastley.

quadrangles that were partially exposed to the wind. Athanasius Kircher was a pious Jesuit priest, and one might venture to suggest that by playing along to, and improvising with these wind-driven harps, Kircher sought to communicate with God through music. In this way, the observer of the winds was transformed from mere witness to interpreter and conversationalist.



Figure 2. Athanasius Kircher's Aeolian-human ensemble [26]

Extending into the 18th Century through parallel movements such as American Transcendentalism, variations in the Aeolian harp's metaphors continued to appear in poetry and literature across geographical camps in Germany, England and the US. Through Emerson's transcendentalist imaginations, the instrument would be elevated to religious proportions as a mouthpiece for the voice of Nature and Beauty:

"It seems as if the day was not wholly profane, in which we have given heed to some natural object. The fall of snowflakes in a still air, preserving to each crystal its perfect form; the blowing of sleet over a wide sheet of water, and over plains; the waving rye-fields; the mimic waving of acres of houstonia, whose innumerable florets whiten and ripple before the eye; the reflections of trees and flowers in glassy lakes; the musical steaming odorous south wind, which converts all trees to windharps. . . these are the music and picture sof the most ancient religion." [27]

In Shelley's poetry, the Aeolian harp becomes a symbol of the human psyche's sensitivity to emotional flux, both externally and internally:

"Man is an instrument over which a series of external and internal impressions are driven, like the alternations of an every-changing wind over an aeolian lyre, which move it by their motion to ever-changing melody. But there is a principle within the human being, and perhaps within all sentient beings, which acts otherwise than in

the lyre, and produces not melody alone, but harmony, by an internal adjustment of the sounds or motions thus excited to the impressions which excite them." [28]

In the instrumentation of the Aeolian harp and its use in literary imagination, there abound similarities in the impetus to use the wind as artistic inspiration for evoking an emotional response.

Data Aesthetics

"A God that can be measured has to be man-made. Revelation has no dimension. If it did, it would be dead in space and time" Robert Smithson [29]

When the Romantic poets wrote about the Aeolian harps, they heard in it a transcendent sonority of the external environment. The harp's mysterious resonance was at once pleasing to the ear and communicative of a distanced planetary circulation of air. Today, the wind and the elements hold more than literary significance. The weather for instance, has increasingly become instantiated in visual graphics rather than physical sensations since our primary experience of it is from smartphone weather updates or from weather reports on television indoors.

Symptomatic of the rise to a *terra notitia* or an *informational* earth, digital sampling abstracts the weather into spliced chunks of information. The array of atmospheric and climate observation systems includes weather radars and satellites, surface observation sites at airports around the world equipped with full range of sensors, and drifting or moored weather buoys offshore, that contribute to providing critical weather information.

The generation of climate information, is a quantitative exercise that involves both observations and forecasting. Through the combined efforts of the assemblages of sensing equipment, observational data is assimilated into computational models for numerical weather prediction [30] Relatively inexpensive climate monitoring tools, coupled with consumer-level micro-computers like the Arduino and Raspberry Pi in recent years allow environmental monitoring to become a citizen science activity. Websites like Wunderground.com, that currently has a network of over 250,000 registered weather stations, allow users to stream live weather updates from their weather stations, creating a digital map of weather data across the world. [31] This reveals a form of aesthetic functionalism, but does this imply a schism between art and information?

Art has always been invested in the aesthetization of information. From early cave drawings, paintings through

the ages, graphic notations, animation and film, information flows through the artist into his canvas. Information design is not a nascent development, but is an age old interplay of impression, abstraction and inscription grounded in an artistic tradition of quantitative mapping and parameter mapping. Albeit, the nascent practice of data representation has placed much emphasis on the constraints of their mediums of propagation whether screens, maps or paper, and the requirements to fulfil a demand for communicative information - designing information today opposes the artistic lineage of an abstract *visual language*. This is the main provocation of media theorist Lev Manovich when he describes the process of data visualization as a revelling in the “anti-sublime”:

“If Romantic artists thought certain phenomena and effects as un-representable, data visualization artists aim at precisely the opposite: to map such phenomenon into a representation whose scale is comparable to the scales of human perception and cognition . . . The macro and the micro, the infinite and the endless are mapped into manageable visual objects that fit within a single browser frame” Lev Manovich [32]

However, artistic activity is not a static process but instead an oscillation between immeasurable and measurable quotients. In the words of architect Louis Kahn:

“A great building must, in my opinion, begin with the unmeasurable, must go through the measurable in the process of design, but must again in the end by unmeasurable. The design, the making of things, is a measurable act. . . What is unmeasurable is the psychic spirit. The psyche is expressed by feeling, and also by thought, and i believe it will always remain unmeasurable. . . To accomplish a building you must start in the unmeasurable and go through the measurable. It is the only way you can build, the only way you can bring the building into being - it is through the measurable. You must follow the laws, but in the end, when the building becomes part of living, it must evoke unmeasurable qualities. The design phase involving quantities of brick, methods of construction and engineering is over, and the spirit of the building’s existence takes over.” [33]

In this way, data aesthetic practices that revolve around the transduction of data from one form to another should aspire to move from the impetus of an immeasurable origin, through the measured resources of computational practices (sonification or visualizations) to the immeasurable outputs of immersive or transcendental experiences. Smithson’s opening quote relates to

information design in being unable to reveal than its measured components, but the affordances that digital media provides us in the freedom we get to choose our tools and aesthetics should allow us to at the very least attempt this lofty ideal.

Cognizant of the way data aesthetics can depict more interesting, uninhibited experiences, I describe a project next in exploring strategies of re-introducing the sublime into data-based projects. To approach elemental monitoring from this artistic context is to acknowledge the observation process itself as a form of composition, and to see data organization and mapping as a form of storytelling.

The Aeolus Notification System

“Why on earth do we ever leave this place no matter how fair the place may be, and then the next place, and the one after that, all our lives long, and I suspect beyond our lives here, because the voyage feels as though it reaches beyond the stars? Of course we never really know. To live is to leave, that is all.” Frederick Beuchner [34]

A pilgrim... a migrant.... a wanderer.... a nomad... all descriptions of a process of constant removal. As Frederick Buechner’s emphatic conclusion reveals, “to live is to leave, that is all”, such is the inevitability of our modern, globalized societies where we are but travellers acting on a universal desire to progress or return to one space or the next.

This inevitability of a journey undertaken not only metaphorically, but also geographically in the sense of a perpetual desire for physical migration can be seen as symptomatic of 21st Century globalisation. Flusser describes Cultural nomadism as a “collapse of settledness” [35] as being a condition that holds not to the possessions and values of settledness at any particular location - not even the assumption of a “heimat” or homeland that one can say she belongs to. Being “free from geographic attachment”, he defines the quintessential role of the migrant in our society today:

“Although the migrant, this human representative of a beckoning future without heimat, carries in his unconscious bits and pieces of the mysteries of all the heimats through which he has wandered, he is not anchored in any of them. . . The loss of the original, dimly sensed mystery of the heimat has opened him up to a different sort of mystery: the mystery of living together with others. . . How can I overcome the prejudices of the bits and pieces of mysteries that reside within me, and how can i break through the prejudices

that are anchored in the mysteries of other, so that together with them we may create something beautiful out of something that is ugly?" [36]

Flusser's proposal of a sort of conviviality in a community is paradoxically created in the absence of a traditional social/nationalistic unit - instead writing in favour of transient and liberal sociality, something he personally experienced in his geographical dislocation from his land of birth to his adopted home in the way he realizes he is free to "choose his neighbours". He continues, perhaps most crucially, in his chapter on "Nomads" where the collapse of settledness and digital societies converge:

"The settled person, the farmer, and the citizen can be localized in space; they have defining addresses. That disintegrates as soon as we compute. Within the network everyone is an omnipresent potential." [37]

Flusser's description of a wanderer through digital space can be seen in the *Aeolus Notification Project*, where all visitors to the installation are imagined as voyagers on the same sea, awaiting a digital wind that symbolically lifts and pushes the visitor in the direction of her destination. Within today's digital environment the metaphor of wind coursing through these systems also references the fluidity by which information *migrates* from address to address. Finally, the narrative of the *Aeolus Notification System* references Odysseus's journey and his encounter with the Keeper of winds, Aeolus in Homer's *Odyssey*. [38] By connecting to these various references, the work proposes an immeasurable quality that arises from the measured quantification of real time wind data.

Installation

The *Aeolus Notification System* was presented at the Design Commission office-gallery space in Pioneer Square in Fall 2014.

At the computer terminal, visitors signed up to be part of the system, providing their mobile phone numbers and the geographical location of a place they would like to be at. This entry was then converted to geocoordinates to be visualized on a user generated map projected on an adjacent wall. Beyond the gallery an SMS notification system ran for a month, comparing the bearings of each user's destination with the current wind direction. When a match was found, an SMS would be sent to the target user with the message: "Dear (user), the wind is currently blowing in the direction of (destination) at (compass direction) (direction) at (speed) . Respond by observing a moment in the direction depicted by your compass" .

With its lines drawn outwards from a central location representing the imaginary passages of each visitor, the *Aeolus Notification System* data visualization served as a cartographic map of longing or desire.



Figure 3. The *Aeolus Notification system* data visualization

In Odysseus' journey, the bag of wind bestowed upon him by Aeolus, keeper of the winds, would ensure the conditions necessary for him to sail home. Likewise, visitors to the installation are presented with a symbolic bag of wind and a compass inside to help them on their metaphorical journey. Each bag bears a print of Athanasius Kircher's 1673 drawing of a celestial being breathing into an Aeolian harp.



Figure 4. The *Aeolus Notification System*'s "bag of winds"

A key part of the installation is the use of mobile technologies as a way to extend the gallery experience

beyond the space and time of a visitor's first encounter with the piece. In the computation of wind direction, the origin is taken to be the gallery space creating a form of memory loop of the installation experience every time the wind blows in the direction of the user's destination. The dispersal of mobile phones away from the gallery space (and possibly around the globe) creates a dispersed audience that ties into the project's symbolic image of geographical expanse.

Conclusion

This paper set out to describe and explore a growing nexus of computational and environmental forms of information in media art history. It looked into the creation of a computational planet, one that is made up of sensor networks monitoring and digitizing the environment. Inspired by Luis Kahn's architectural works that incorporate the sublime into its design, I propose that a key tenet of data aesthetics is not the acceptance of the "anti-sublime" but instead in an assertion of the role of data (or any transductive) arts to be that which converts an immeasurable component into a measurable quantity, and subsequently reveals this as an immeasurable experience.

In thinking about the extensions of organic life into digital systems – an 'afterlife' of elemental media (of breath and of wind), I have explored superficial connections to indigenous and transcendental literature, but this are forays into a myriad of cultural sensitivities and histories that require a further measure of research and embodied immersion. Going forward, locating specific cultural practices that identify with such neo-transcendentalist philosophy could yield more insight into how we might be able to construct more 'immeasurable' experiences with our data.

Finally, in considering strategies for an affective use of environmental data, the work *Aeolus Notification System* provides a way for elemental media such as the wind to transcend a simple informative or functionalist paradigm and to exist as a metaphor or narrative for emotional engagement in an artistic system.

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Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Slow Selves Futures: Embodiment and Upending Extractive Industry War Machines

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Abstract

The theorist Katherine Hayles has strong critique for those positioning the humanities adjacent to processes of nonconscious cognition such as the choices of a human cell or the vast databases of the tech industry. This presentation views the work of a controversial female citizen videographer who confronts laborers on natural gas fracking sites in Pennsylvania and exposes these awkward and extraordinary encounters on the distributed networks of YouTube. The presentation analyzes Hayle's concepts of human choice or will as it might relate to human consciousness confronted with opposing material networks in the midst of confronting ecological destruction.

Keywords

Katherine Hayles, nonconscious cognition, cognitive assemblages, video art, natural gas fracking, Deleuze, war machine, ecological activism, solastalgia.

Introduction

Citizen videographer, Vera Scroggins, has been documenting the rise of natural gas infrastructure, drilling, pipeline, and compressor stations since 2009 in Northeast Pennsylvania. As natural gas companies spread through the rural countryside bending and breaking environmental laws and generating citizen out-rage and also copious new wealth, Scroggins traces her own contiguous lines driving down company roads and walking across legal property boundary lines to confront her fellow citizens, and natural gas workers to understand their work and also alert them personally to the harm they were causing the community. [1] These encounters and over 700 other personal diaries and activist videos are hosted on YouTube and have drawn hundreds of international visitors to the area to investigate further the visual clues of ecological harm the videos present. Scroggins has been harassed, arrested, and legally confronted for trespassing and other minor infractions related to her work bringing these images to the larger world.

As one views Scroggins's work, the role of distributed citizen journalism on-line comes into sharp focus. Scroggins can be seen as a cognitive hub in a network or assemblage of international online amateur media un-fact checked and unfettered unleashing dystopic and utopic possibilities. This presentation views Scroggins's embodied media making activities toward respect for human consciousness as they brush against the ethical possibilities in her relationship with the concepts of cognitive unconsciousness. In searching for complexity one can find rich destinations in the role of nonconscious cognition discussed by Katherine Hayles layered and contrasted with the legacy of Deleuze. [2] [3]

Video

"Bloodland V3" is a video artwork featuring presentation and analysis of the work of citizen videographer Vera Scroggins as well as other anonymous gas field citizen protestors. The piece and related works have toured the Eastern US and Australia in solo and group gallery exhibitions. The work was given an International Critic's Pick by Artforum.

Audio

The audio component of "Bloodland V3" is partially created by processing field-recordings of noise from natural gas compressors and methane venting sites.

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Catherine Pancake is an award-winning filmmaker, video, new media, and sound artist. She has exhibited at national and international venues such as the Museum of Modern Art (MoMA,) Royal Ontario Museum, Baltimore Museum of Art, Murray Art Museum Albury, Australia, Shanghai Conservatory – Shanghai PRC, and Academy of Fine Arts, Prague. Pancake's narrative and experimental documentary work has been screened at over 150 venues nationally, as well as broadcast (entirely or as excerpts) in the US and UK on the Sundance Channel, PBS, FreeSpeech Television, and the CommunityChannelUK. Her films are nationally & internationally distributed by Bullfrog Films and Canadian Filmmakers Distribution Centre and are held in permanent collections in over 75 university and museum archives nationally. Pancake is an Assistant Professor in the Film and Media Arts Program at Temple University.

Imagination and Accountability:

Grounding Possible Futures in Art and Biology Artefacts

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Abstract

Variables of privilege and discrimination used as political tools for struggle can no longer be sustained in current biotechnological transformations—such as gene editing—and in our postantropocentric awareness. Transgressive creative alternatives are necessary and can come from speculation and fiction, and, I argue, from the hybrid materiality of Art and Biology. This paper argues that this alternative can be found in the Speculative Imagination of Alfred North Whitehead as an intellectual exercise of responsibly opening up to “the possible”, reconnecting with the materiality of art and of biomatter to recover accountability as theorized by Rosi Braidotti’s New Materialism, and functioning as Donna Haraway’s SF Hybrids in the post dualistic struggle. The most basic example of life, microorganisms, is used as the subject of this hybrid material speculation, expressly in *The Yeast and the Host* by Philippe Parreno, *Nomadic Plants* by Gilberto Esparza and *Micro-rhythms* by Interspecifics. This project maps out an area of alternatives that advocate political accountability in the logic of the posthuman

Keywords

Art and Biology, Art and Science, Posthuman, Epistemology, Speculative Imagination, Science Fiction, New Materialism.

Introduction

We are eager to move on from what feels like an obsolete theoretical frame. It is tempting to imagine possible futures whereby the old class, race, and gender categories will be obsolete. Developments in biotechnologies, specifically in faster gene editing, are transforming our construction of categories and axes of oppression that make traditional categories seem outmoded.

To substitute them, speculation, fiction, and imagination have an extraordinary epistemological power to imagine possibility. Science fiction can be a form of speculative reasoning in contrast to dominant modes of futurity. [1] This has led to a vogue of multiple propositions of possible futures. This paper looks at the fictional narratives generated around material artworks, the world they imagine and the links to the materiality that grounds their addressing of power struggles.

When speculating possible futures, we run the risk of

losing political accountability in the fractures between the actual and the proposed, becoming uncritical, supporting mainstream narratives and dominant relations of power. This is a search for concrete and actual strategies not to disavow, not to lose accountability in the fractures between now and the possible futures, advocating/searching for a way to bridge the fissures between fictional narratives, speculative fabulations, and situated material accountability.

Background

We have not yet overcome the power abuse and discrimination that intersectional perspectives aimed to tackle. In the urgent need to address discrimination, we resource to categories such as gender, class, and ethnicity that are the same used to emphasize negative difference, but these categories are not only strongly debated but highly dependent on a modern understanding of “the human” and therefore, highly anthropocentric. They assume a human subject where those categories can take place. The anthropocentricity where intersectional critical theory took place is now in crisis by a series of biotechnological transformations and of philosophical posthuman approaches coming themselves from critical theory. As an example from feminist theory, Rosi Braidotti describes the posthuman firstly as a way to overcome a humanism that confers subjectivity only to male, white, heterosexual, property-owning. [2] This process opens up to bodies that usually represent the inferior other that can be exploited, but also to other forms of living matter. Braidotti has brought forth the problematic of giving up with subjectivity, something some subjects never had. [3]

In the last century, categories such as race have been proven to be a construct [4] based on the perception of specific superficial traits that have historically been used to define negative difference and justify oppression. In a different way, gender has been proven to be highly culturally constructed around physical specificities. Matter and its meaning are inseparable and build each other, therefore there is so much culture and social order imposed on a body. Moreover, simple technologies like pacemakers or more complex projects aiming at merging AI with brains make cyborgs part of the present horizon. In

a more invasive note, biotechnological transformations such as gene editing make hybridity and boundaries ever more blurry among species.

What this dissolving of categories makes evident is that our contemporary intersectional axes are useful only as tools of political struggle but the present needs cartographies that include non-human others and their specificities and that would need some extra intersectional considerations.

As a first approach that did not risk a deeper transformation, is the often neoliberal anthropomorphization of “nature” as capital to preserve, which allows for conscience washing “green marketing”. Environmental “green” ecologically friendly facades have been adopted, for instance, by political parties [5] and the “green” marketing [6] by corporations. This includes practices such as the anthropomorphization of the needs and desires of animals, and the protection of certain species-like companion species- over others that become extinct.

Accountability, Political Responsibility in the Posthuman

In order to find less neoliberal approaches to the subjectivity crisis supposed by the postantropocentric turn, Art and Biology can offer an interesting space of proposal and an excuse to reframe our understanding of the living and the new politics of power distribution within those logics.

As I have briefly delineated so far, there is a need to develop concepts and perspectives more adequate to the complexity of the posthuman, in which suffering and death are part of the living, but are not distributed on a logic of privilege, exploitation, and capital. To find alternatives, this research resources to the works produced at the intersection of art and biology, but acknowledges other disciplines and methodologies might be equally fruitful, like science fiction, which I will briefly address later.

Speculation, Materiality, and the Hybrid As an antecedent, the 2008 financial crisis and the recent interest in Speculative Philosophies from Meillassoux and Whitehead has triggered great interest in the concept of Possible Futures. [1] Studies on science fiction are abundant, but the need of utopia and dystopia was consistently dealt with by progress vs utopia [7], utopia and science fiction. [8] From an art perspective, we are still to understand if the materiality and hybridity of art and biology works could bridge the theoretical process of speculation and narratives of fiction to accountable materiality and situated embodied production of ideas and art.

Speculation: Whitehead, possibility, imaginative generation.

I am resourcing to Whitehead as the opening up of possibilities of thought, without losing the capacity to act in the present. I am interested, firstly, in the power of imagination to propose and transform the present, particularly as propositions of post-anthropocentric

intersectional approaches. In the case of fiction in narrative, we could think of Octavia Butler’s well known *Bloodchild* story as a form of political awareness and intersectionality in a posthuman context. [9] And in Margaret Atwood’s *Oryx and Crake* where many issues of gender violence and racism are overcome in the gene-edited posthuman species of the Crakers. [10]

The imagination of possibility I will address in works of Art and Biology relates to science fiction but differs in materiality and affect. Here a related term that can be useful is “imaginative generalization as ‘the play of a free imagination controlled by the requirements of coherence and logic’”. [11]

Michael Halewood’s interpretation of speculation in Whitehead is, as he specifies, not in the dictionary definition of groundless or uninformed conclusion, but in the acknowledgment of the impossibility of complete information, “speculation could be seen as a useful tool which recognizes the incomplete and processual character of the world and invites us to develop approaches to thinking and research which bear witness to the inherent dynamism of existence.” [12] Speculation and imaginative generation in Whitehead are therefore useful concepts to understand the double operation of opening up of possibilities in the fictions, and setting up limits in the operating of thought, as I argue material and situated.

Speculative formulations are a form of fiction that can at least partially be actualized materially, in the process of thinking by doing. These speculative formulations, following Haraway in *Staying with the trouble*, are a mediation among the sensible and intellectual knowledge. [13] They have an extraordinary epistemological power to imagine possibility. These materialized forms of science fiction can function as speculative reasoning to contrast with dominant modes of futurity [1], which in the present have led to a vogue for multiple propositions of possible futures. Thus, it is becoming a trend in philosophy to look at the notion of possible futures.

Even if fiction is recognized as a fertile field to imagine alternative futurities, there are many ways in which the material thinking of Art and Biology separates from narrative science fiction. As authors like Jens Hauser [14] have noted, it has to do with the affective response to the presence of the biological.

Materiality: New Materialism

This project resources to New Materialism, particularly from the school of thought of Rosi Braidotti, as a way of grounding the biological materiality of Art and Biology practices. One crucial goal of this Feminist New Materialism is not to lose political accountability after the linguistic and poststructuralist turns. As an alternative, New Materialism, as an embedded and embodied brand of Materialism, establishes a mutual relation between matter and meaning [15], in which they become inseparable. There is a correspondence between meaning and matter, as matter cannot be understood naturally but only through the subjectively given meaning. In other words “Objects do not

precede their discourse; discourses constitute them as epistemological objects of knowledge”. [16]

Feminist New Materialism can be a resourceful approach to understand intersectional political accountability after the postantropocentric turn. For instance, Rosi Braidotti as a posthuman feminist has worked for decades on the paradoxes of post identitarian philosophies and the politics of those who never achieved subjectivity. [3] Moreover, its post-dualistic operation of the inseparability of matter and meaning acquires a particular meaning when dealing with art, and with living matter in art. The meaning of the work is inseparable from its materiality, this biological materiality meaning is in constant transformation and affects our notions of subjectivity and agency, therefore acts simultaneously as a philosophical theory and political stand, useful in the working of posthuman intersectional political accountability.

Hybridity, Donna Haraway’s SF
A hybrid notion coined by Donna Haraway, that is helpful in the understanding of Art and Biology is SF. The intentionally polysemic initials referring to string figures, science fact, science fiction, speculative feminism, speculative fabulation, so far [13]. The characteristic of SF is being wide open, an ongoing process of thinking, as its last meaning “so far” points out it. Simultaneously, SF refers to a very well defined area of flexibility to understand, through critical theory, intersectional views represented by speculative feminism, the creative possibilities of science fiction and the biological concern and the value to help understand the world of science facts. The term might cause discomfort in academic contexts for its diverging and sometimes contradicting senses, but it is fruitful to understand Art and Biology because it can address the hybridity of materiality and fiction, its interstitial position. SF is a form of understanding Art and Biology and its enquiries, to give value to its propositions as an open-ended process without the constraints of institutional science, with the opening of possibilities of speculative thought and imagination, and with the non-essentialist grounding of New Materialism, in its artist and biological matter. In other words, to preserve a powerful capacity of speculation without losing accountability, by imagining strategies that balance political accountability, with scientific speculation and a valuable esthetical experimentation on materiality.

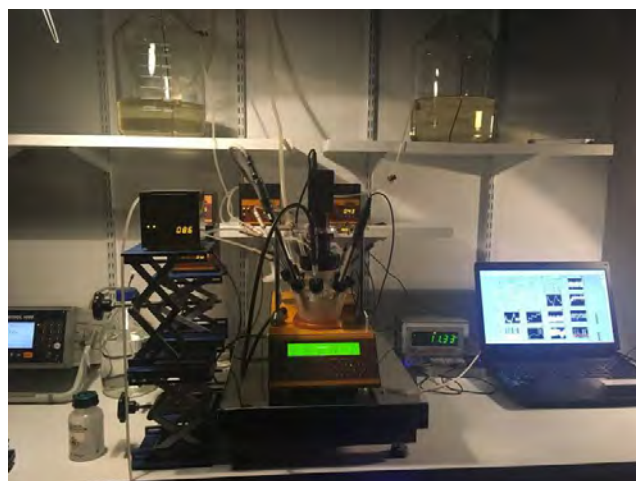
SF allows for an alliance of science, art and activism. It is a form of tracing to understand what are the politics of who lives and who dies, and for cultivating multispecies justice beyond environmental justice. [13] Therefore it is related to the New Materialist quest for accountability and a “third-wave” form of intersectionality and environmentalism.

The hybrids of artworks in the intersection with biology can teach us to generate situated speculation, grounded fiction, and a place to start questioning how to generate practices embodied, strong against an abstraction that denies the material specificities that are a condition of possibility, and the specific politics that inform it, invisibilization privilege oppression and exploitation.

Accountable speculation examples: Future speculations vs present responsibility

There are many well-known artworks that also fit in this perspective, such as the genetic interventions of Joe Davis, Martha de Menezes or Eduardo Kac himself. However, I will approach posthuman agency and the environment in more recent hybrid systems of microorganisms and machines, with audiovisual outputs that suggest having an autonomous behavior related to the microbial behavior. This section describes the works, the fiction, the material speculation and the philosophical implications for a postantropocentric intersectional accountability. [13]

Philippe Parreno: *La levadura y el anfitrión* The work is a complex experience affecting and affected by the behavior of microorganisms, specifically yeast. *La levadura y el anfitrión* [*The Yeast and The Host*] (Jumex Museum in Mexico City, 2018), by Philippe Parreno is an intricate staged event that follows a program determined by a dynamic system that regulates the order of appearance of events in the gallery: films, musical compositions or sonic events, and even the performance of the marquee in the first floor. This system is mutually related to the yeast hosted on the second floor. The yeast lives in a bioreactor with controlled conditions that vary according to outside weather conditions. The yeast’s behavior is monitored and the information collected is used as the input controlling all the variables that happen in the exhibition.



Bioreactor in *La levadura y el anfitrión* by Philippe Parreno, Museo Jumex, January 2018. Photograph by the author.

There is ambiguity in the way the work is presented; this ambiguity opens up the possibility for the fiction to be implied in the narratives. It is not clear what is “controlled” by the yeast and what factors affect the yeast’s conditions. In the exhibition, there is no disclosure on how information from weather or the host affects the yeast and how the yeast activity is translated as information to what happens in the rooms. The host is one of the six casted interpreters that conduct and trigger in collaboration with the yeast and the algorithm the stages in the event.

Fiction and Material Speculation The main narrative made possible by this ambiguity is that the yeast somehow

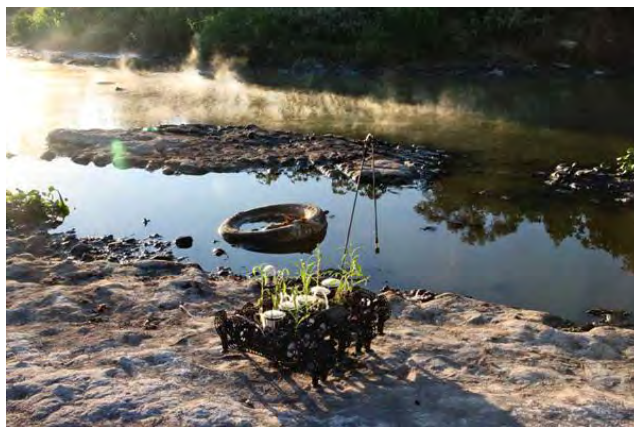
controls the event, that it controls the system and the program. The control of the show is turned to natural and algorithmic systems, it is performed as an automata, where microorganisms connected to a computer “learn to adapt to events triggered by a human host” [18] when s/he decides to screen a video or play the piano. As fictional as these suppositions might be, the speculation is material. The yeast is present; byproducts of its metabolism are being produced and stored next to the bioreactor. Outdoors stimuli affect its metabolism and data recorded from it is a source that affects the event. Microbes might not be connected to a computer, but are monitored by it; the date appears on them in real time.

Philosophical implications What are the implications of this material speculation? Of this ambiguous presuppositions? Within in the event, it implies a relationship with non-human others, the being and creativity outside of human-directed forces. It acknowledges a non-human intelligence that includes the simple artificial intelligence of algorithms and the microorganisms as intelligent matter. The idea of life becomes unclear, when the yeast might replace the computer as a program, a living organism becomes the “computing” machine. This vision is not completely mechanistic, for the yeast as intelligent and agential as it is portrayed it is also undisciplined, unpredictable and not progressive.

The example of the *Yeast and the Host* is an opening to the post-human in arts and its theoretical implications. Next, I will introduce an artist that can also be read within this postantropocentric propositions and develop the intersectional positions of view from the material speculation and fiction of their narratives.

Parreno's work is an appropriate way to open up to non-human control even if it has a deeper interest in art as a non-controlled event. It is interested in the immateriality of experience in art: events. I will now introduce the work of Gilberto Esparza that relates more closely to intersectional responsibility in a postantropocentric present.

Gilberto Esparza: *Nomadic Plants* is a symbiotic device with eight legs, powered by the energy produced by Microbial Fuel Cells that are part of its body and are fed with polluted water from the river. *Nomadic Plants* (2008-2013) cleans the water in the MFCs from the river while harvesting the electrons from the bacterial metabolism, and with the cleaner water hosts plants on its back.

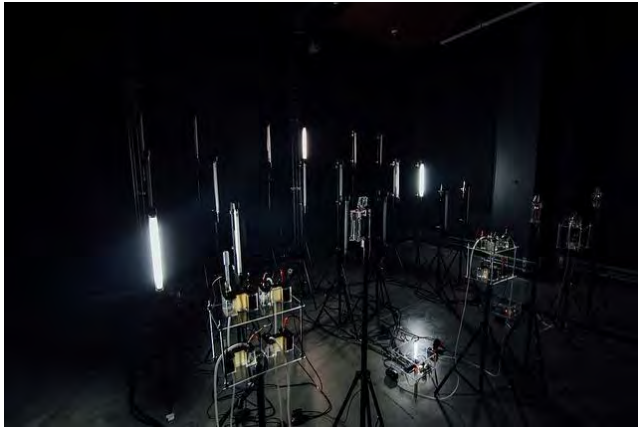


Nomadic Plants (2008-2013) by Gilberto Esparza, courtesy of the artist.

Fiction and Material Speculation In *Nomadic plants*, the fiction is that of a self-sufficient creature, a form of artificial life. There is a storyboard, a comic strip [19] where a self-sufficient mechanical creature subsists in an even more polluted river by harvesting the energy its bacteria metabolizes from polluted waters, generating a micro oasis of clean water for other species. In the story and in the project, *Nomadic Plants* has some form of culture, a sonic expression out of exceeding energy that it emits during a moonlit night. Outside of fiction the machine actually exists, but the amount of energy that can be harvested from the bacteria makes it hibernate most of the time. The symbiotic machine and the bacteria remain between fiction and realization. The story in the comic strip ends when the environment is transformed and the creature does not make it in time to find another polluted river, and therefore dies, after which one of its plants develops into a tree that overgrows it. In this context, the possibility of the rivers to heal remain only in the fictional terrain as one of the possible futures.

Philosophical implications. *Nomadic Plants* presents the possibility of a non-fossil source of energy that is also a living source of energy. They are an ideal embodiment of a hybrid of machine, plants and microorganisms that interact with the environment but do not intend to solve the pollution problem by itself. It is not an anthropocentric drama portraying the consequences of pollution on the human body, the story and the existence of *Nomadic Plants* brings attention to the polluted river, to the need for cleaner water for the survival of the diverse living beings, without presenting a moralizing good and bad binary situation for humanity. It importantly presents bacteria as crucial agents that allow for the life of the creature.

Interspecifics: *Micro-rhythms*. (2016) *Micro-rhythms* is a bio-driven installation where small variations in voltage inside Microbial Fuel Cells (MFC) are monitored and translated into combining arrays of light patterns. A pattern recognition algorithm detects matching sequences and turns them into sound. The installation amplifies the micro-voltage produced by these microscopic organisms and transduces their oscillations into pure electronic signals with which they create an audiovisual system that evokes the origins of coded languages.



Micro-rhythms. (2016) by Interspecifics. Courtesy of the artists.

Fiction and Material Speculation A foreign signal is produced from the data of the electron release in the MFCs, a coded message that we cannot understand. The fiction is the possibility of communication, of reading and somehow understanding bacteria from the electrons released by their metabolism. Is it possible to make sensible the presence of bacteria, can we hear bacteria? Can we perceive bacterial activity? Can we conceive of biological-technologically hybrid creatures? Is the machine learning from bacterial behavior, is communication and understanding possible?

As in other cases, the speculation is materialized by the presence of bacteria and the actual monitoring of their release of electrons. This information is used as the variable that translated by an algorithm is represented by light. A form of AI is indeed monitoring the light and learning from the patterns. Although most research is concerned with chemical quorum sensing as a form of communication of bacteria, some research also indicates they could be communicating through electron flows as well. [20]

Philosophical implications One of the aspects that comes to the fore in *Micro-rhythms* is the postanthropocentric question of how can we displace subjectivity to include bacteria? It necessarily opens questions of biological chemical process inside bacteria that release electrons, which form electric impulses that are translated into light and then sound. These questions are different from what other kinds of research would ask. It seeks to include microorganisms and machines as an agent, as a participating collaborators of the work.

Discussion

As an interweaving of the theory that precedes the brief approximation to the works, this discussion makes a matrix of the postanthropocentric intersectionality in Art and Biology, of the presented artworks using microbes in interaction with algorithms and machines. The fictional narratives around them are analyzed in the context of speculation, new materialism and, SF. Representing a desire to donate agency to the microbial, Speculation, New Materialism and the Hybridity of SF are the axes to access the artworks and approach a intersectionality in the present with suggestive explorations instead of universal truths and

control. These explorations are grounded and keep awareness and accountability in power distribution and derive in a postdisciplinary challenge of boundaries.

The first move suggested was that of imagination, of daring. Speculative Imagination, as conceptualized by Whitehead, can be used to understand *The Yeast and the Host* by Philippe Parreno. In the event, which is highly polysemic and ambiguous, nothing is definitive. There is an intention of losing control to the non-human other, to the yeast, at least the desire creating an unpredictable experience when agency is relinquished to the minimal form of unicellular life, bestowing it with subjectivity.

To preserve a powerful capacity of speculation without losing accountability, New Materialism understands matter and discourse as mutually enacting, as inseparable. Materiality grounds the imagination, in the example in this paper, microorganisms have specific capabilities and limits that bound the works themselves. Discourse generates categories and reality but its itself related to flowing material referent. In *Nomadic Plants* by Gilberto Esparza the hybrid creature makes reference to who has the right to live and die in the present damaged environment, the possibility of a plant-machine-bacterial hybridity as a non-human subject is presented. It is an imagination strategy that balances political accountability, with scientific speculation and a valuable esthetical experimentation on materiality. The materiality of concrete fiction, should not be a limitation, but an awareness of the values each material enactment implies in it. In this way, the debate takes place in the present, materiality is about the responsibility of the present, not the future.

The works of Art and Biology that I have referred to, can be described as SF hybrids, in their reference and resourcing to biological sciences—science fact—and to the narratives they propose playing in the limits of the factual in their science fictional narratives. In particular, *Micro-rhythms* explore a third wave feminist speculation where the intersectional axes of oppression are displaced in the exploration of a more diverse collaboration. The tracing and visualization of the electrical impulses of bacterial metabolism are also the visibilization of an intelligence, an unpredictable, complex order, and the desire of interaction. Why is the subjectivation of microorganisms so relevant to this debate?

Microbes are the minimal form of living other, taking the discussion on alterity in the axes of intersectionality to the limit. To the place where not any living being requires human rights, for this would place man again in the center as measure and reference of all things. These works of Art and Biology suggest that the politics of life have to be reconsidered questioning the privilege of men, beyond understanding life as form of capital, but as self-organizing and agential.

Conclusions

In order to find less neoliberal approaches to the subjectivity crisis supposed by the postanthropocentric turn, Art and Biology can offer an interesting space of proposal

and an excuse to reframe our understanding of the living and the new politics of power distribution within those logics.

Speculation, as an exercise of thought in fictional narratives around Art and biology opens up possibilities, in this case choosing microorganisms as the most basic example of life for the speculative exercise in thinking power relationships and oppression. Their art status allows for the freedom of not giving definitive results or answers, to generate concepts without the pretension of truth. As it has been discussed, it is the materiality of art, of the algorithm-controlled machine and of the microorganisms that hold the speculative process accountable, within the limits of what the living cells can achieve, how they can actually behave.

This material speculation takes place in the Hybridity of SF, in the in-between space of an enquiry about the world, and the risks of an alternative vision and understanding challenging borders, concepts and dualisms in their ambiguous interdisciplinary materiality.

Whitehead fuels imagination in order to depart and land in different disciplinary fields, this procedure is an open a bridge to think materially. Posthuman intersectional political accountability requires the courage of this kind of grounded speculative imagination. With this analysis, I seek to describe one path through New Materialism, Art and Biology, to open up to alternatives, to break with deeply rooted anthropocentric, patriarchal, class oppressive, racist, speciesist relations of power. It is an opportunity to break away, to stay accountable without limiting the possibilities of imagination in dealing with the complexities of the present.

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Born in Mexico City, Mariana Pérez Bobadilla is an Art Historian and DIYBiologist concerned with the intersections of Art, Science and Technology. She received an Erasmus Mundus Scholarship to study a Master in Gender Studies at the University of Bologna, Italy, researching Feminist Epistemology and Contemporary Art. She has presented her work in ISEA 2012, and has been involved in the Mexican Pavilion of the 56th Venice Biennale. Her academic training includes courses with Rosi Braidotti, Magali Arreola and the international curators course of the 2014 Gwangju Art Biennale, in South Korea. Awarded by the Hong Kong PhD Fellowship Scheme, her research in the School of Creative Media revolves around Art and Biology, Epistemology, History of Science, deep time histories of representation, New Materialism, Biohacking, Wetware and bacteria.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Void: Breaking Boundaries Between Senses

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Abstract

Void is a sonic, haptic and augmented sculpture exposing its participant to different auditory spatial experiences as he/she moves around and touches the sculpture in the form of a hanging topography. The purpose of this experience is to create an invisible spatial sonic architecture that is defined by the quality of the participant's touch and the geolocation of the participant's body in space during different times of the day. This is an individual experience for each participant through a headphone. As each participant enter the designated space and put on the headphone, he/she would hear an ambient sound. As they start to move in space some audio parameters of what they hear would change based on his/ her head movement. Finally, when they get close to the inverted topography they can touch and speak to the sculpture. The sound of participant's touch would become part of the background sound. Their whispers become part of the sonic memory of the experience.

Keywords

Installation, Interactive, Sonic, Haptic, Augmented

Introduction

Void is a sonic, haptic and augmented sonic sculpture exposing its participant to different sonic spatial experiences as he/she moves around and touches the sculpture in the form of a hanging topography. The purpose of this experience is to create an invisible spatial sonic architecture that is defined by the quality of the participant's touch and the geolocation of the participant's body in space during different times of the day. This is an individual experience for each participant.

Concept

The approach of this experimental and performative project emphasizes sensory and spatial perception of viewer's

interaction within the space. The goal is to give the participant unexpected experience of his/ her act of being and interacting in the space. In other words, the ultimate goal is to create a conflict between senses and initiate moments of anomaly in viewer's perceptions of the space. The sonic experience will be heard through headphones.

Design Question

The main question in this performance is how can a space become the vessel, containing a series of invisible events and agencies from different timescales and atmospheres, letting the human body play this 'spatial instrument'? Specifically, how would human body position itself in a space constantly filled with the back and forth interactions between the haptic and audio senses of the participant. How would one's body interact with the space that is filled with sonic layers of events and geo-memories?

Impetus and Audience

"We began as a mineral. We emerged into plant life and into the animal state, and then into being human, and always we have forgotten our former states, except in early spring when we slightly recall being green again."

Rumi

Impetus and Significance

Barry Blesser, in his book *Spaces Speak: Are You Listening*, differentiate between the sensory experience and the physical identity of a stimulus:

"What does it mean to explore a phenomenon? An explanation is never the phenomenon itself, but only a refracted image of it, like looking at a scene through a prism. Although models, theories, and pictures are not reality, they

present aspects of a phenomenon. For example, in dealing with musical space, a composer sees one aspect of the phenomenon, whereas architects, archaeologists, anthropologists, audio engineers, psychophysical scientists, and blind individuals each see other aspects. When we have access to multiple views, each with its own biases and limitations, we acquire greater understanding of the phenomenon. As we explore these views, we must remember that each version of a phenomenon is always constrained by the questions being asked about the answers being offered. On the other hand, the union of diverse viewpoints, like multiple shadows from an object that we cannot see, allows us to form an image of the phenomenon, which by definition remains inaccessible.” [1]

Looking into this multimodal experience as a phenomenon with different layers of sensory feedbacks, puts one’s in a better situation of looking into the interactions away from any categorization. It is difficult to categorize sensual experiences. Hence the impetus here is to explore situations breaking the border between different perceptions and senses. Like a prism this experience has a range of colors in different wavelengths. It starts with locating one’s physical body in a space, hearing the background ambience sound which works as a trigger to invite participant to move around the space. Gradually the participants may realize their presence in space has some effects on the sonic parameters they hear. As their curiosity reaches its peak while touching the sculpture, participants would feel the sense of embodiment as they touch the sculpture. The auditory experience of the piece transport participants constantly in the virtual space that is formed around their head and body.

Audience

The purpose of this experience is to offer its participant an unexpected experience of his/her act of being and interacting in the space and the sculpture, initiating moments of anomaly in participant’s perceptions of the space. The scale and enclosure form of the sculpture create the opportunity for the piece for not being completely dependent on the space, yet it is preferred that the sculpture be installed in a quiet corner in a gallery space (open or closed). As the result of physical form (the height), the piece can be more fathomable for adults above the age of 15. The low height of the piece (which will be hung), would let the participant bend and walk on knees beneath the piece as they touch the sculpture and interact with it.

As mentioned the objective of this experience is to change the perception of the viewer’s perception of his/ her environment. Hence the wandered(participant) thinks he/she is within another invisible world and he/ she can interact with this hidden world of sounds. The idea here is to instantiate the question of whether there are other layers of reality in our existing world; the world of materials

spices and objects that are covered with layers of memory and data.

As each participant touches the piece he/she would hear the sound of his/her touch resembling the feeling of embodiment by the object that they are touching. As if the sense of scale is lost. Now they are inside and within the object that they are touching. Yet the space is filled with sounds and memories of that object and previous participants. There will be four embedded microphones inside the piece with light indicators that motivate participants to touch and speak to the fabricated topography. (The sound of participant’s interactions with the piece will be recorded and in the next performances and will gradually become part of next audios).

Domains and Precedents

Domains: Hierarchical Map

This project has been significantly impacted by reflection from number of existing works from the field of architecture, sound art and conceptual art.

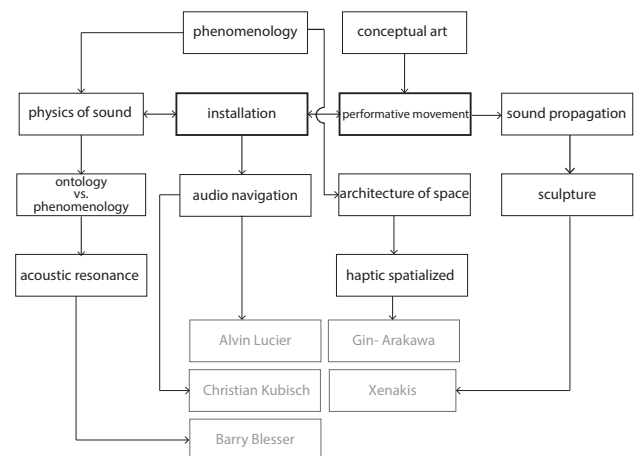


Figure 1. Domain Map

Conceptual Art

The process of creating *Void* was driven by the navigation of body within and between spaces that are both visible and invisible in order to create a playful experience for different senses (haptic and auditory). The aesthetics, objective and mechanics intention was creating a playful environment for participant to shift between different points of the space as they interact and move in the designated space.

“In conceptual art the idea or concept is the most im-

portant aspect of the work. When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair. The idea becomes a machine that makes the art.” [3]

In *Void*, the inversion of the machine made landscape created a negative space for its participant to have a very personal experience through his/ her touch, body and head movement within an invisible sonic landscape.

Space and Sound

One critical challenge in the development of *Void* was the creation of a balance between the relationship between the space and sounds. At the first place why there needs to be some notion of a physical form(sculpture), which in this case defines the borders of the space. At the second place, how the physical form of the sculpture enriches and embody the experience with sound itself. The specific form of the sculpture through the milled layers of foam created such a range of different physical forms that can resonate a divers produced audio experiences as the participant touches the surface. At the same time the physical movement of the body in space constantly changes the flow of the tones in the space.

In Madeline Gins and Arakawa project “Reversible Destiny”, inspired by Hellen Keller, as residents walk in the interior spaces their bodies continuously stimulated by the situations created around it and with it. The floor is an uneven fabricated surface with vertical poles to assist moving within the space. At first glance it seems an uncomfortable space to navigate through, however after spending enough amount of time the body familiarize itself to move around. Here the body is located between different uncomfortable situations, a consistent struggle for a being. This example is more related to the situation of one’s body in space.

In Alvin Lucier’s project “Vespers”, each performer is equipped with a Sondol and asked to move blindfolded inside a defined performing space. The Sondols emit short, sharp pulses at variable repetition speeds, and the pulses produce echoes from the reflecting walls of the space. The echoes are used for orientation. Lucier had in mind that the performers, in doing this, are taking a “sound photograph” of the space. Each echo reveals a little detail of the surrounding space. Thus, the whole piece is like a panoramic, acoustic photograph, made up of uncountable individual shots. It is a sonic navigation through and within the space.

Virtual Spaces for Sound and Music

The notion of three- dimensional sound has evolved from 20th century. Spatial perspective and geometric projection and invention of vanishing point in painting was applied by Renaissance painters from fifteenth and sixteenth centuries, in which added different layer of accuracy and representation to observing the environment. “Objects and spaces could depict strong emotion and intense symbolism precisely when they were no longer constrained by having replicate physical attributes. For example, in Salvador Dalí’s “The Persistence of Time”, melting clocks— virtual objects—communicate the concept of subjective time, even though they have no ability to track the passing of time. Time is, after all, relative and personal.” [1]

Throughout the evolution that happened in the perception of reality and virtual, the subjectivity of reality was revised. For instance, during twentieth century the rules of classic physics changed by atomic physics and new inventions. Matter was energy, time and space merged, and solid objects were voids. These small changes evolved the concept of space and music as well.

“For modern composers, dispersing musical sources throughout a space is no longer revolutionary; location is an active component of a composition. Antiphony and spatial distribution evolved into a space-time continuum, which Maja Trochimczyk (2001) calls ‘spatiotemporal texture.’ At any time, a musical voice could appear from any direction, and by intentionally sequencing attributes of space, time, pitch, and timbre, a voice can create the illusion of movement (changing position) and transformation (changing size)” [1].

Hence looking into the space and sound without any physical constraints helped Void to move beyond the physicality of the space.

Installation and Performance

Sculpture

It can be said the pioneer of cultural form and sound was Iannis Xenakis work in Philips Pavilion at 1958 World’s fair that was designed by Le courbusier. This project was the cross section between architecture and music. Xenakis described this sculptural installation as “... an Electronic Poem and a vessel containing the poem; light, color image, rhythm and sound joined together in an organic synthesis.” [3]. The experience of walking through the pavilion and the audio experience of listening to the composed piece is and exclusive constant shift between the physical installation and sound that blends together back and forth.

Phenomenology

The 20th century advent of environmental philosophy and posthuman studies has widened our perception of ecosystems, animals, objects, and artificial intelligence. However, the vast majority of these entities remains beyond intellectual concern. In *Alien phenomenology*, or *What it's like to be thing*, Ian Bogost develops an object-oriented ontology that puts things at the center of being- a mode of thought in which nothing exists any more or less than anything else, in which humans are not the sole or even primary elements of interest. And unlike experimental phenomenology or the philosophy of technology, Bogost's alien phenomenology takes for granted that all beings interact with and perceive one another. [2]

Edmund Husserl in his writings explains the concept of noesis and noema. Noesis is the object perceived through consciousness and the noema is the object in its natural objective form. In Husserl's theory, noema is the physical sound waves that cause the vibrations in both the air and material that either can be sensed by skin or through secondary object (in this case embedded microphones). The noesis is the layer of perception by which we separate those paired experiences into disjoined senses. (touching the sculpture).

In other words, phenomenology offers a different understanding of the reality and relationship between objects (as they like human beings communicate with each other). In *Void* participant's presence and movement in space become the bridge between objects' realities and human realities. The experience is a constant shift between what we see, what we fathom in the flow of invisible reality and sounds.

Methodology

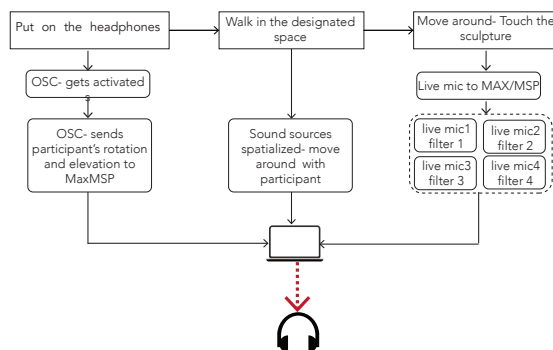


Figure 2. User Flow Diagram

Project Mechanics

The approach of this experimental and performative project emphasizes sensory and spatial perception of viewer's interaction within the space. As the viewer touches different parts of the fabricated topography, the amplified sound of his/her touch will be combined with another sound that is mapped over the fabricated topography. If the participant is not near the topography to touch, then the audio source will rotate around the participant during the length of the experience. After all, the viewer would hear the sound of a composed soundscape.

The mapped sounds for this piece act as an audio representation of certain timescales. The combined sounds will be re-constructed in a software (MAX/MSP) and each viewer will hear a different sound that has a different spatial quality of the space. For instance, as the participant touches a surface there will be different granulation of the touch sound. These effects will be created in the MAX patches on the back end.

This piece is experimental both through its design process (choice of material and technology) and user experience. Each participant gets a different sonic experience based on the quality of his/ her touch. This piece is performative because each viewer acts as a real time composer of the sounds in the space.

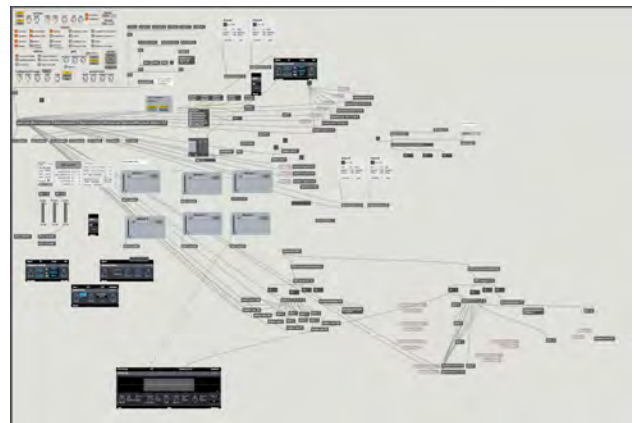


Figure 3. MAX/ MSP Patch

Spatialized Sound

The selected audios are pre-recorded audios from the album "*Inuksuite* " by John Luther Adams that was scored for 9 to 99 percussion players who are meant to be widely dispersed in an outdoor area. The choice of audio is related to the concept of this project because *Void* meant to create a sensation of an outer space. The title of Adam's al-

bum(Inuksuite) refers to the Stonehenge- like markers used by the Inuit and other native peoples to orient themselves in Arctic space. The choice of these audios could be related to the spatial navigation and exploration of the space. They are not melodic pieces and are more ambient sounds. John Luther Adam structured the rhythmic layers in the score to mimic these stone shapes, but there's an open- endedness to how much music is performed that reflects the sense of freedom behind it. The audio sources will move around in space as the participant walks around. Each one of these tracks can be translate as an individual musical note. In combination they can be translated as an orchestra that the participant would conduct it. Base on the head and body movement the frequency of the audio will be mixed and change through a special filter in MAX patch.

Microphones

There are four microphones embedded inside the physical sculpture (topography). These microphones will pick up the participant touch sound as they touch the sculpture. The picked up sounds will be amplified and the proper audio effect will be added to them in MAX.(granulized)

Sculptural Form

A 3D fabricated model in a form of topographical landscape was generated through several processes in 3D software (Rhino and Grasshopper) in order to give the resemblance of a geological landscape and sense of enclosure. The formal complexity of the form creates a diverse textural geometry to produce range of sounds as the participant touches the surface. Whereas if the viewer had to touch a homogeneous flat wooden surface the range of the sounds wouldn't be diverse.

In addition, there is a metaphoric relationship between the form of the object and the geological landscapes. Meaning through different timescale the climate and geographical conditions left physical marks and traces on the body of rocks and minerals. In a way this project offers a new sensational experience through touching geological landscapes as if a participant's touch enables him/her to feel and fathom an invisible reality.

Fabrication

Initially the sculptural form of this piece was supposed to be fabricated from the honey-comb cardboard with 1-inch thickness. But after several restrictions and consideration the 4-inch purple insulation foam was used. The choice of the material gave the opportunity of being able to collect sound more properly. Because of the physics of the foam, the sound would resonate and travel inside the material. This selection helped a lot in not using so many microphones input sources.

Material Iteration

A wide range of materials were tested for the audio / resonance reflective qualities from the early stages of the project. Since the goal was to get the maximum range of sounds from interaction with the material, the first test was with guitar strings that were tight and stiff from both ends. The sound quality of this iteration was diverse, yet the formal expression of the material was not conceptually appealing, but helped me to try to develop the concept of sound variation through choice of material.

For the second iteration, the honey-comb cardboard was picked (Figure 4.) The internal geometry of the material would give the resonated sound different pathways to travel across the material. However, the stacks of the material needed to be milled by C.N.C(Computer Numerical Control). But after doing a test, the edges of the milled surface wouldn't be clean and the material was ripped off at its edges.

In addition, because of the large size of the sculpture, milling the piece would take enormous amount of time so efficiency of the material selection mattered. The next option in this case was sheets of foam. In order to be more efficient since there are 56 layers of 1-inch foam cuts, the 4- inches thickness foam was selected in order to compress the milling process.

Later on, through the process it was decided to drill holes for hiding the microphones, therefore foam would be the best option to cut holes within. In order to attract participant's attention to microphone, single LED lights was installed inside the microphone holes.

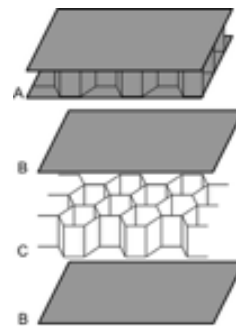


Figure 4. Internal Geometry of Honey Comb Cardboard

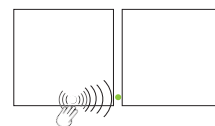


Figure 5. Sound Resonation through Foam

another invisible space.

Choice of Technology

Sonic Elements

The main two elements of this project are touch and spatial sound. The choice of material is in direct relationship with touch. At this point the main issue was what materials or objects can be used in order to get the most diverse range of tones and resonance? Through the first experimentation a small topographic physical model made of card board was tested. The friction between the hand and the card board creates a heavy low tone sound. However, through the user test sessions, it was suggested rather than using the cardboard layers, I may use metal sheets with a gap in between (Figure 6). This air gap would let the material have more resonance. But the problem with metal sheets is the high cost of C.N.C fabrication. As the final decision the 4-inch foam was selected. (Figure 5)



Figure 6. Choice of Metal sheets and Guitar Strings

Use of Headphones

The experience of the participant will be heard through the headphones. There was a lot of discussion and struggles around the notion of using headphones or stereophonic recording for loudspeakers. However, headphones destroy the perception of the external space and location. In other words, the audio sources and spatial acoustics exist inside viewer's head and between his/ her ears. Yet when the user listens to a real environment the sound at both ears are identical. Having the physical constraints of the physical environment urged me to use headphones in addition to the possibilities that the current technology provides to create specific geo-location of the sounds. So the participant can have the 360 experience of the designed environment and sound.

These opportunities would not be possible in the real open environment. In other words, it is easier to control the sound direction and environment if the user wears headphones. Finally wearing headphones carries the notion of inspecting the environment through this mysterious experience. The idea here was to let the listeners feel they are embodied by the environment and the surrounding sounds of this physical and virtual space. As if they are within

User Interaction Scenario

As the user enters the designated space (Figure 7), he/ she puts on the headphone. There is a headphone inside a box on top of the headphone which send the rotation angle of the head to the O.S.C software (OSCulator) to Mac (Figure 8). The X, Y and Z numbers will be received in the Max patch. These numbers define the exact direction and angle of participant's head. Based on how the participant moves his/her head the quality of audio changes. The first audio track rotates around participants' head with a specific speed. The third and fourth audio sounds can be heard equally across the space. But the quality of the sounds changes based on how fast or slow the participant moves his/ her head. As the participant gets closer to the sculpture he/ she would observe the LED lights inside the sculpture and gets attracted to the microphones. Participants can freely interact and touch the areas around the microphones in different parts of the sculpture. At this moment participant could hear the sound of their touch over the foam. If they get close enough to the microphones they can speak to the microphones (Figure 8,9,10,11). These conversations and sounds will be recorded and will be played as the background sounds in the next performance. The level of these audio tracks changes on different timings of the performance. (Figure 12,13, 14)

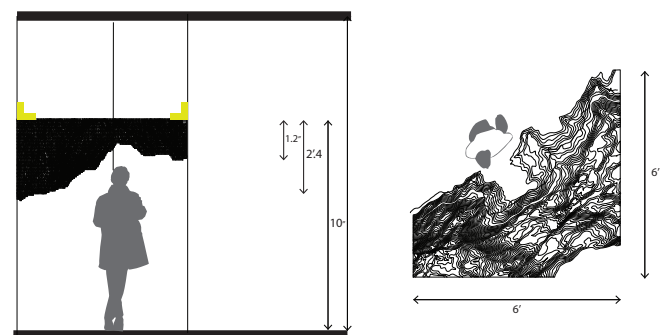


Figure 7. User Interaction in Space

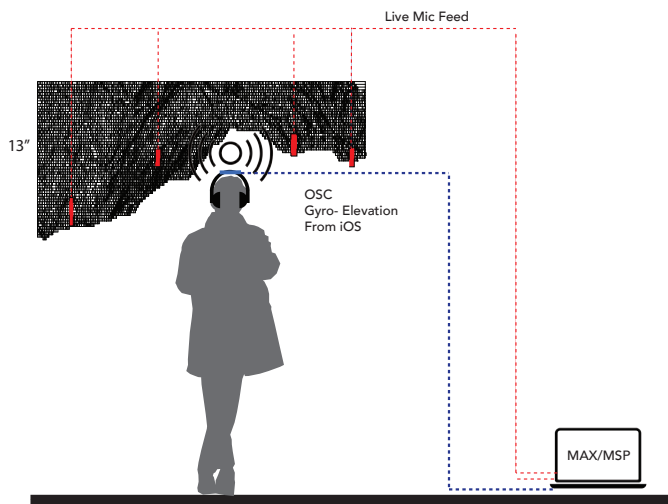


Figure 8. User Interaction Scenario



Figure 9. Microphones in Different Locations

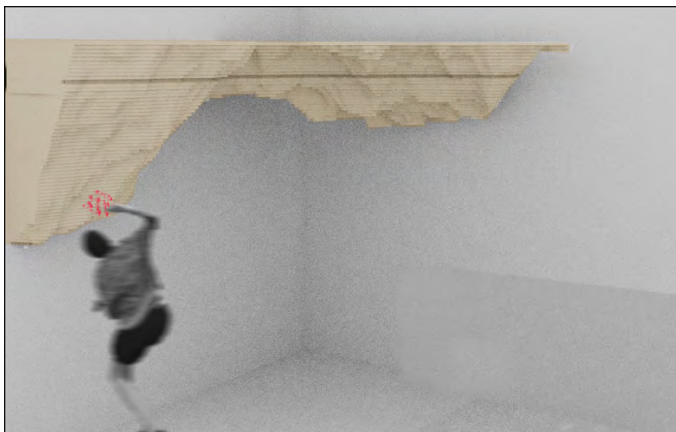


Figure 10. Microphones in Different Locations- Lower Heights

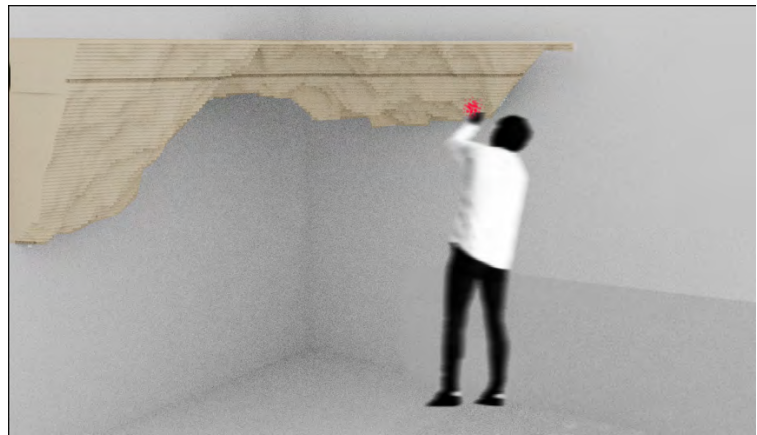


Figure 11. Microphones in Different Locations

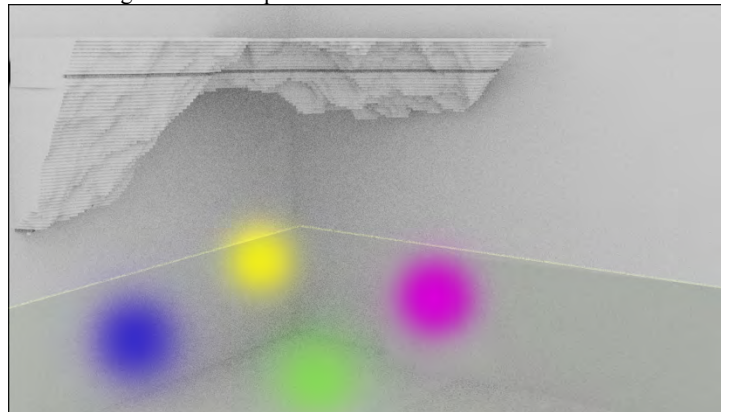


Figure 12: First Level of Audio Location, Beginning of the Installation

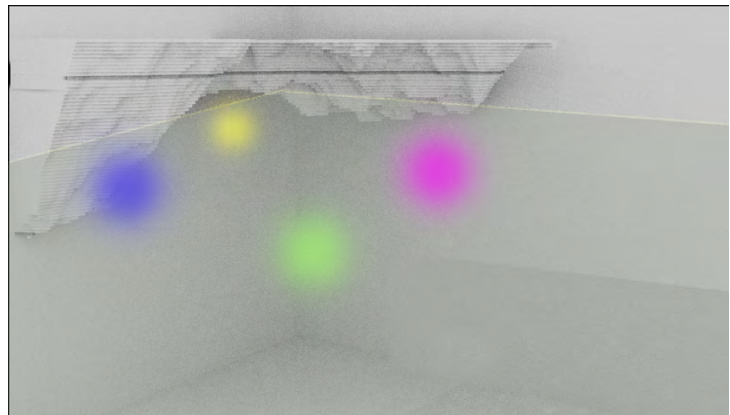


Figure 13. Second Level of Audio Location, Middle of the Installation

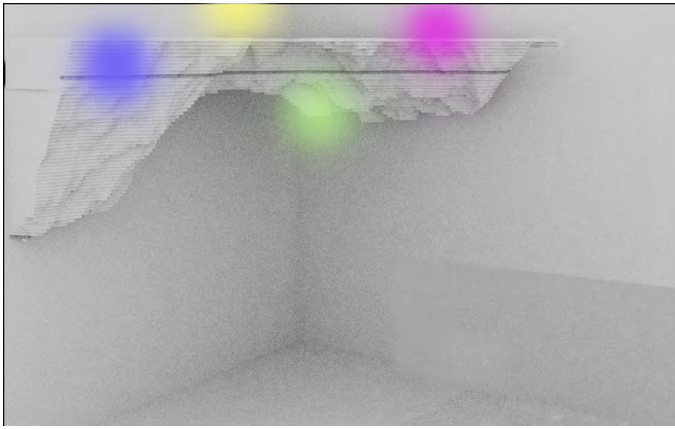


Figure 14. Third Level of Audio Location, The End of the Installation

these iterations. Another interesting opportunity for future iteration is to work more closely with musical composers and musical instrument designers as well as performance dancers. What if the form of the designed musical instrument becomes a landscape for participants and dancers to interact with? So the geometry and form of the musical instrument can generate certain type of sounds as the movement of the participant/ dancers is tracked in the environment.

Finally, the way we frame haptic and auditory experience has the potential to impact the way we interact and listen to our environment. *Void* is about adding a new layer of understanding of the environment to participants' sub-consciousness. A critical method of examining the natural and artificial environment.

Evaluation

Process

Void started as an experimentation with auditory and haptic senses in both physical and non-physical environments. In a way or so this project could be translated into a similar experience in a virtual space. However, the physicality of the sculpture mattered in order to make more sensual connection and later on, interaction with the participants.

Through participant's interactions and conversation with the piece (as they may talk to the microphones) layers of individual memories will be added to this experience. That's why it is necessary to record both auditory and haptic interactions in the space.

The sculpture needs to be experienced in situ. And one of the points might be how participants experience of the piece can be different if the environment that they are located in changes (i.e. from quite gallery space to a natural quite landscape environment).

Next Steps

The abstraction of this piece, it's close relationship to participant's interactions and the relationship of the whole project to its surrounding environment suggests future iterations. The discussion and feedback about the possible venues that the experience takes place and the process of creating layers of sounds which will gradually evolved through out different shows would be the core material of

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Author Biography

Mina Rafiee is a visionary designer and architect. Her body of work explores innovative human/ non-human centered experiences through interactions with objects, physical and virtual spaces and environments. Emphasizing on both micro and macro scales of human interaction with events and “things”, Mina creates haptic immersive experiences that engage the senses and allow for exploration of physical, sonic installations and imaginary worlds.

Through her design practice, she constantly questions and re-imagine the ways one can interact with different environments and contexts, whether it is an interactive machine- made landscape or an immersive imaginary world.

Mina’s projects include, but not limited to, physical objects, short films, speculative objects/ landscapes, soundscapes, collages and drawings, all of which attempts to engage the audience with her anthropocentric dilemmas.

Ammerman Center for Arts & Technology 16th Biennial Symposium

INTERSECTIONS

Trading System: Bio-Economic Fairy Tales in the Anthropocene

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Abstract

This paper provides a brief overview of the theory and in-progress realization of a new project entitled “Trading Systems: Bio-Economic Fairy Tales in the Anthropocene.” The project explores the overlapping trajectories between economics and the sciences, specifically biology. It questions how these intersections between social systems and non-human ecologies are situated within our current anthropogenic, socio-political climate. Through whimsical, speculative visualizations realized as drawings and sculptural installations that utilize citizen science models of sustainable technology, the project aims to ask, what more equitable and “chthulucentric” [1] societies can we imagine outside of our current “fairy tales”?

Keywords

economics, biological market theory, speculative design, alternative energy, citizen science

Introduction

“Trading Systems: Bio-Economic Fairy Tales in the Anthropocene” explores the notion of the anthropocene, our current epoch in which human impact has significantly altered the earth’s geology and ecosystem, and what it might look like if non-human forces could be put in the driver’s seat. For example, what happens when models of non-human ecological systems are used to identify and rethink the dysfunctional systems, the “fairy tales,” that are currently troubling our social welfare, economy, and governance? The project (in progress) is a series of speculative visualizations – whimsical “wetware” biological circuits that move between 2D and physical space realized as diagrams and sculptural installations.

Project History

“Trading Systems” evolved out of a recent project that uses the metaphor of a garden and its struggle to survive to depict the complex relationship between economic growth and human life. The project, entitled “Reversal of Fortune”

and completed in 2015, maps the intersection of finance, philanthropy and crowdfunding. It is comprised of two robotic gardens, “Garden of Virtual Kinship” and “Planthropy” that take the form of 3-dimensional visualizations. An additional schematic “circuit” drawing illustrates the garden’s conceptual/material relationships and data flows.

Plants in the two gardens represent human lives, creating a more physical, sensorial experience with data and the abstractions incurred through their networks. The lifelines of the plants – water – are dependent on the actions of social media users. These users, who are either donating on charity-oriented crowdfunding platforms or posting through cause-related Twitter hashtags, activate mechanical watering systems.

Theoretical Influences

Print manuscripts two columns to a page, in the manner in Prior to this project I had not worked with living material as a medium in an artwork, nor do I have a green thumb (although it has gotten greener as I continue working with plants and microorganisms). What became apparent as I delved deeper into the intersections between plants and other non-human living systems and social systems, specifically economics and forms of governance, are their parallel and overlapping histories.

The development and evolution of economics is closely intertwined with biology. Dating back to the late 18th century, myriad articles note the close connection between biologist Charles Darwin and economist Thomas Malthus. Malthus’ “Essay on the Principle of Population” written in 1798 which focused on the human struggle for survival incurred by hunger and disease due to population overgrowth, directly influenced Darwin’s theory of natural selection. [2]

In more contemporary forms, economics and now its related but detached sidekick, the world of finance, interface

with the biological through appropriations and reappropriations of theories around complexity, adaptability and today's favorite buzz word – resilience. What C. S. Holling defined in 1973 as resilience in ecological systems as a concept for understanding, managing, and governing complex linked systems of people and nature has become a totalizing ideology for reproducing the logic of neoliberalism. [3]

For example, I recall seeing on numerous financial and banking institutions web pages for personal financial planning questions such as “What’s your financial appetite?” Often accompanied by images of shiny, red apples, the analogy between eating habits and financial habits is evident. Personal finance has become naturalized. The rhetoric and image underscore a directly comparable relationship between a healthy attitude towards money and debt with seemingly natural and mundane discussions about healthy eating. [4]

We have entered a new conceptual framework of worldmaking in which humans, along with their institutions, must function similar to plants, animals, microorganisms and even rocks – as adaptive, decentralized and self-organizing in a world that is always at “risk”, another popular buzzword. As social welfare continues to be shattered, only the adaptive, decentralized and self-organizing will survive in a Herbert Spencer-esque narrative of “survival of the fittest”. [5]

Thinking about the topic of resilience within the context of political economy can become a depressing matter. Yet political economists such as James Brasset and Chris Holmes at The University of Warwick in England have focused on the aspect of “uncertainty” within resilience thinking as a space of potentiality. In a recent article, they raise the idea of a “productive ambiguity.” [6] Influenced by Judith Butler’s seminal text “Performative Agency,” they ask how resilience is performed in different contexts outside of more dominant attempts at prescriptive solutions. Brasset and Holmes are interested in the temporality of resilience and the way it can enable multiple and varied behaviors to be revealed over time. For them, uncertainty is a form of “productive ambiguity: neither structure nor subject is ever fully defined and thus remains open.” [7] I see this idea as somewhat of a dialectic constructed between notions of resilience and uncertainty that are both oppressive but also liberating.

This brings me to Donna Haraway’s current book “Staying with the Trouble: Making Kin in the Chthulucene” which has become one of the most referenced books within the anthropocene/post-anthropocene discourse. In the book, Haraway speculates a chthulucene, an alternative to the human-centric binary anthropocene, in which she imagines a sympoiesis—a making-with and a becoming-

with in which all players, both human and non-human render each other capable as “civic subjects and objects in intra-action.” [8] In this vision she challenges homogeneity and the idea of a generalized equivalence and emphasizes that a recuperation from our current environmental crisis and broken system can be enabled across consequential differences.

This idea of a “sympoiesis” as expressed by Haraway is at the core of “Trading Systems.” “Trading Systems” plays with metaphors of the “trader” and “markets” and how economics and finance are visualized and mapped by creating incongruent mixtures between non-human ecosystems and human centric models of economy and governance. In these rather absurd remixes, the streamlined mechanizations of capital get messy – and even dirty (like real dirty, as in soil and mud and even bacteria), as a way to interrupt the current narrative. By provocation, amplification and inspiration, the project aims to make visible both potential and problematics of other realities.

Process

In the initial phase of the project I have been focusing on biological markets, the behaviors of microbes, and their potential in redesigning human economies on both a local and global level. The idea draws from studies on sexual selection, mutualism and cooperation in the 1980s by evolutionary biologists such as Ronald Noe and Peter Hammerstein which show that non-human agents exchange commodities to their mutual benefit but that the exchange value of these commodities can also be a source of conflict. [9]

In more recent studies by microbiologists such as Toby Kiers based in Amsterdam, research is being conducted on how to experiment with ways to manipulate “market conditions” between microbes in order to create more sustainable food production and environmental remediation. Using an anthropomorphic approach, the microbiologists are re-framing the microbial behavior in economic terms, examining the way they “exchange goods” or “allocate resources.” [10]

But Kiers and her collaborators clearly state in a gesture against instrumentalization that “The goal of biological market theory is not to draw analogies to human markets. Rather, biological market theory is a tool to analyse exchange patterns. When applied correctly, it allows scientists to make testable predictions about resource exchange patterns and how they vary across species and environment.” [11]

Working from this approach, I have started creating 2D and 3D visualizations, simple circuit flow diagrams and accompanying physical, sculptural realizations that merge

the visual language of schematic diagramming and systems animations with citizen science. The creations playfully explore these “trading systems” – exchanges and relationships between plant-soil ecosystems and current economic theories and catch phrases.

For example, what does mapping a supply and demand circuit with a mycorrhizal fungal network reveal? How can we rethink “trickle down economics” through the behavior of parasitic plants? Take for instance, a simple supply and demand economic diagram that shows the relationship between labor, production and the market and remap that “circuit” through the lens of a plant-soil ecological “circuit”. The leaves of the plant supply the labor as carbon drains into the soil to facilitate production and activate minerals and carbon. This exchange with the plant become the market as a variety of underground organic networks – plant roots and microorganisms – compete for resources. The two systems, the human and the non-human, are visualized as an intersecting circuit through a series of clear plastic terrarium installations that enable viewers to see the live, real-time interfacing, similar to a science exploratorium exhibit.

I am also experimenting with citizen science platforms, such as microbial soil-charged batteries and fruit-based power sources and how these simple physical systems can interface with the flat surface of the 2D diagram as a form of speculative design and problem solving, creating a simple “wet” circuit.

Other experiments include working with physarum polycyphalum (slime mold) and mycelium (mushroom roots) at the Coalesce Biological Arts Lab at my university, SUNY Buffalo. I have been exploring how these semi-intelligent organisms respond to various stimuli such as food sources and human-made topographies with the aim of incorporating them into the visualizations.

Conclusion

As stated at the beginning of this paper, the project is very much in progress. Through this “biomimetic” interplay between the cultural and the organic, I aim to make visible both the potential to illuminate new models and the risk of social engineering. The project seeks to draw out, literally, the cognitive dissonance created when one uses the model of non-human ecological systems to identify and rethink the dysfunctional systems of social welfare, political economy, and governance.

And I should mention that there is also a performance in the works – imagine Bill Nye the Science Guy meets Paul Krugman who has become a feminist economist.

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Author Biography

Stephanie Rothenberg’s interdisciplinary artworks make visible the physical and imaginary networks that create technological utopias. Moving between real and virtual spaces, she explores how new technologies mediate our everyday experiences and connect us to larger global systems. Her work has been exhibited in venues including House of Electronic Arts (HeK), MASS MoCA, LABoral, Sundance Film Festival, Transmediale and ZKM. She is a recipient of numerous grants and awards including a Creative Capital. Residencies include the LMCC Workspace program, Eyebeam and the Santa Fe Art Institute. Her work is in the collection of the Whitney Museum and has been widely reviewed including Artforum, The Brooklyn Rail and Hyperallergic. Rothenberg received her MFA from The School of the Art Institute of Chicago. She is Associate Professor and Director of Graduate Studies in the Department of Art at SUNY Buffalo. <http://www.stephanierothenberg.com>.

INTERSECTIONS

Computed Curation

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Abstract

The article provides a contextual overview for my piece *Computed Curation* — a photobook curated by a computer that offers a glimpse into the metrics, aesthetics and poetry of machine learning, computer vision and their visualization tools.

Keywords

photography, computer vision, machine learning, visualization

Introduction

Computed Curation is a photobook created by a computer. Taking the human editor out of the loop, it uses machine learning and computer vision tools to curate a series of photos from an archive of pictures.

Considering both image content and composition — but through the sober eyes of neural networks, vectors and pixels — the algorithms uncover unexpected connections and interpretations that a human editor might have missed.

The book is an accordion photobook with a total length of 95 feet, featuring 207 photos taken by the artist. Each page includes with the photo a computer-generated caption as well as tags of the assumed contents.

Technical Process

The book consists of 207 photos taken between 2013 to 2017. Metadata was collected through Google's Cloud Vision API (tags, colors), Microsoft's Cognitive Services API (captions) and Adobe Lightroom (date, location). Composition was analyzed using histograms of oriented gradients (HOG)¹.

Considering more than 850 variables for each photo, a t-SNE² algorithm arranged the pictures in two-dimensional space according to similarities in content, color and composition. A genetic TSP algorithm³ computed a shortest path through the arrangement, thereby defining the page order.

The book layout was generated using a custom Node.js application and rendered in InDesign using basil.js. Margot Fabre collaborated with the author on the book's layout. It is printed on a HP Indigo digital press and hand-bound as an accordion book with a total length of 29 meters (95ft).

¹ An algorithm used in computer vision for object detection. Oriented gradients describe the predominant direction of lines of pixels in a subsection of an image. The histogram of oriented gradients encodes the distribution of horizontal, vertical, and diagonal lines. [1]

² t-distributed stochastic neighbor embedding; a popular algorithm to reduce data with thousands or millions of dimensions (i.e. attributes) to two or three dimensions perceivable by humans. [2]

³ The traveling salesman problem (TSP) is a classic computer science problem: Given a list of cities, what is the shortest possible route that visits each city exactly once? [3]



Fig. 1. Computed Curation book, partially folded open.

Reflections

The initial idea for this project came from my desire to make a photobook from the pictures I had taken over the years, paired with the anxiety of having to select from thousands of photos which ones to print and how to arrange them (which in retrospect, of course, would have demanded much less time than the project ended up taking).

At the time I had noticed the booming interest in artificial intelligence and machine learning which seemed to be fitting technologies to automate the work I was dreading.

Google, Microsoft, and others offer ‘off-the-shelf’ solutions for machine learning based computer vision, e.g. to caption images or generate tags based on their content. Experimenting with these tools I quickly became fascinated by the often times odd captions and tags that I got back in response to my pictures (which did not reflect the clichéd training pictures that the software was trained to recognize and thereby seemed to push the software to its limits).

Although the tools I used are incapable of respecting historical, emotional, or really any kind of context of the photos, I noticed that they are still capable of helping me see my pictures in a new way: I began to discover themes and connections that I had not noticed before.

The visual connections between images are often obvious. Sometimes, however, the viewer has to become more analytical to find patterns: she has to compare multiple pages; look at colors, objects, composition all at once and figure out what led the software to that specific arrangement. Although a somewhat accidental discovery, this aspect is one of the strongest qualities of the piece: the book actually teaches the viewer how to see the world from the eyes of an algorithm.

The Politics of Artificial Intelligence

Computed Curation offers a glimpse into the machine’s “reasoning” and thereby helps (to some extent) unpack a black box technology that puzzles even the researchers and engineers who created it.

Artificial intelligence is increasingly part of our everyday life in every area imaginable. [4] We don’t usually notice it and the technology in many cases makes our lives (seem) easier.

In an essay titled “Invisible Images (Your pictures are looking at you)”, artist Trevor Paglen describes that most digital images today are made by computers for other computers. He’s talking about the technology that drives increasingly ubiquitous computer vision software, for example in police car license plate readers or Facebook’s face detection feature.

Invisible images and the invisible logic that they emerge from are, as the name suggests, rarely ever seen by humans. And if they are, even their creators often do not understand precisely how the machine made or understands them. Paglen, whose work frequently deals with uncovering secret military operations, argues that invisible images exercise on us “exceptional forms of power flowing through the invisible visual culture that we find ourselves enmeshed within.” [5]

We rarely ever notice these forms of power — until the technology fails. It is within its glitches when A.I. exposes its politics and biases: Google’s image detection software tends to identify light handheld objects as burritos or Wii remotes, because the software was trained by youngish engineers in the San Francisco Bay Area where the mission style burrito was invented. Similarly, but more serious, the same software classified black people as gorillas due to the fact that the training data contained mostly white faces. These are not problems of inaccuracy that can be easily fixed, not bugs in the system, but expressions of the politics of the training data, the software, and the creator. [5] Hito Steyerl describes them as “condensations [...] of the current technological disposition[,][...] hardwired ideologies and preferences.” [6]

In this sense by using existing software, my book became a reflection of not only my own worldview, but also of other people’s biases. They become very obvious in the generated image captions and tags: Computed Curation has its fair share of wii remotes; and people doing things usually default to men, hinting at a gender disparity in the training data: “a man riding a skateboard”, “a man riding a bike”, “a man playing frisbee”. There are more examples like this, bearing the fingerprints of all those who have indirectly contributed to the work.

Conclusions

Machine learning based image recognition tools are already adept at recognizing training images (umbrella, dog on a beach, car), but quickly expose their flaws and biases when challenged with more complex input. In Computed Curation, these flaws surface in often bizarre and sometimes poetic captions, tags and connections. Moreover, by urging the viewer to constantly speculate on the logic behind its arrangement, the book teaches how to see the world through the eyes of an algorithm.

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Link to Computed Curation

A digital version version of the book can be seen online at <http://philippschmitt.com/computed-curation-web>.

Author Biography

Philipp Schmitt is a designer and artist based in New York. Born in Würzburg (DE) in 1993, he received a BA from Hochschule für Gestaltung Schwäbisch Gmünd (DE, 2016) and studied at Designskolen Kolding (DK, 2015). He is currently a graduate student in MFA Design and Technology at The New School (US) and was previously a Research Fellow at MIT SENSEable City Lab (2017).

Philipp's work revolves around design and technology as subjects instead of considering them solely as tools. He is interested in exploring and articulating their applications and implications for the future.

His work has been published, exhibited and awarded internationally. Notable features include publications in *Wired*, *CAN*, *Form*, and *Spiegel Online* and exhibitions at the Vitra Design Museum, Science Gallery Dublin, Festival Images de Vevey, Vienna Biennale, and IEEE Vis.

Dual Rendering of Virtual Audio Scenes for Far-field Surround Multi-channel and Near-field Binaural Audio Displays

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Abstract

Dome-shaped audio displays, by nature, surround the listeners. Accordingly, in rendering 3D virtual audio content, they are very good localizing more distant sound sources in far-field, and from all directions. Unfortunately, these audio displays are not optimized for the rendering of virtual sound sources located in the near-field (inside the dome). On the other hand, binaural audio displays incorporating Wave Field Synthesis (WFS) related techniques are able to render virtual sound sources between the audio display and the listener. We investigate here the idea that near-field and far-field audio content can effectively be presented by simultaneously combining these two kinds of audio displays. We implemented a prototype and presented it during the last IX symposium at the [SAT]. We describe here how we built this prototype and report our findings: our prototype was effective regarding 1) the performance of the simultaneous rendering of both fields, 2) the set up time (few calibration parameters), and 3) perception during the transition state between the two renderings.

Keywords

Audio spatialization, live rendering, virtual reality, hybrid audio display

1 Introduction

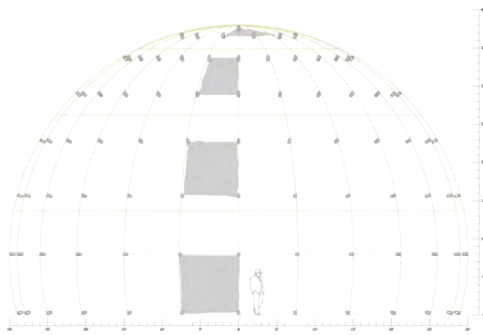
This paper presents a prototypical audio rendering system that was demonstrated in the 2017 IX symposium at the Society for arts and technology [SAT] in Montreal. The development of the system was motivated by our experiences in rendering audio for multi-channel loudspeaker configurations, such as the Satosphere of the SAT, a 11.5-meter high dome-shaped audiovisual display with 31 channels of audio mapped to 157 surrounding loudspeakers. In configurations of this sort, one common audio perspective is rendered for a single group of people located within the dome. For these kinds of systems, we have observed that the rendering of virtual sound sources is most perceptually effective when these sources are located beyond a particular distance



Figure 1: Demonstration of our dual audio rendering prototype during the IX symposium at the Society for Arts and Technology. The MyBeam Speaker arrays are located in the center of the dome, where the visual of the virtual audio scene is displayed.

from the virtual listening point in the audio scene. In practice, this distance has corresponded to the distance from the virtual listening point to the loudspeakers, say around 6 meters, in the case of the Satosphere dome. However, when locating virtual sound closer to the virtual listening point, at a distance of say, less than 6 meters, the rendering is quite unconvincing; the perception of proximity to the source is vague, while the intimate space surrounding the listener remains “vacant”. Our observation correlates with sound localization perception study that emphasizes the importance of distance cues, and more particularly, the perceptual difference between close sounds (located at “arms length”) and far sounds [1].

Borrowing from the literature [2], we adopt the terminology *near-field* and *far-field* to refer, respectively, to the space in the virtual audio scene immediately surrounding the Virtual Listening Point (VLP), and the surrounding space at a distance of greater than one meter. The near-field is of particular interest since within it, binaural localization cues vary



(a) The Satosphere is large scale audio display able to host many listeners simultaneously.



(b) The MyBeam speaker array is a portable audio display delivering highly detailed stereo image without headphones.

Figure 2: Audio displays of our prototype.

with source distance (and not relative incidence): as the ratio of distances from the source to the closer and further ears increases, so does the interaural intensity difference, due to the effect of head-shadowing. With this in mind, and given the limitations of the Satosphere dome audio display system to deliver these kinds of binaural localization cues to auditors in the near-field, we adopted a hybrid audio rendering system consisting of the dome's far-field audio display and several near-field *open-air* binaural audio displays, each capable of delivering a discrete binaural audio signal to nearby listeners without the need for headphones. For each audio display, the audio scene is specifically rendered; both displays combine to create a perceptually continuous and more homogeneous listening experience of sound sources at all distances, giving sonic liveliness to the previously "vacant" space around the listener.

Our prototype aims to improve the perception of sound sources that lie within the "vacant" space that is bounded by, and to the inside of the surrounding audio display, and in doing so, open the door to artistic exploitation of the sonically intimate space around the listener.

2 Rendering multiple, simultaneous audio displays with SATIE

Our previous works with SATIE and the dome at the [SAT] addressed spatialization and composition methodology. The work focused on immersive environments with a single audio display composed of several speakers, and more particularly, the dome audio display [3, 4]. Our prototype, described in next section, is built on top of several technologies and adaptations we made to SATIE. This section describes in more detail, the two audio displays we used: the 31 channel dome at the [SAT] and the binaural WFS portable speaker bar from Comhear¹. We also describe here how we enabled

ambisonic rendering in SATIE, as required for the binaural computation for the WFS audio display.

Audio displays

The dome at the [SAT] is called the *Satosphere*. This dome forms a 360-degree spherical projection screen where 350 visitors can be accommodated in an 18 meters diameter and 11.5 meters high space. The Satosphere is used as a space for the tangible, inclusive and immersive experiences such as movies, visualization projects, dance or game programs that explore new conceptual and sensory territories on a human scale. The Satosphere is equipped with 8 video projectors & 157 speakers. Figure 2(a) shows the scale of the Satosphere and how the speakers are disposed around the dome: any direction from horizon to the top can be computed using standard panning algorithm such as VBAP [3].

Figure 2(b) shows a MyBeamTM speaker array from Comhear. It is a binaural WFS portable & open-air audio display. It can render sound sources outside (and in front) of the audio display itself while providing a coherent stereo image for potentially multiple listeners without headphones. As described in [5], the speakers use an innovative method for the optimization of beamforming, to control a small speaker array in the production of spatialized, localized, and binaural virtual surround or 3D sound.

The SATIE audio engine

SATIE [3] is an audio rendering engine built with the SuperCollider [6] audio programming system. It takes advantage of the SuperNova [7] server for efficient, parallel computation to deliver many audio sources spatialized over many audio channels [4]. SATIE's architecture is designed to be modular and uses the plugin paradigm to create structures combining audio sources, effects and spatialization algorithms (VBAP, ATK, AMBIEM, SC-HOA is underway)

¹<https://www.comhear.com/>

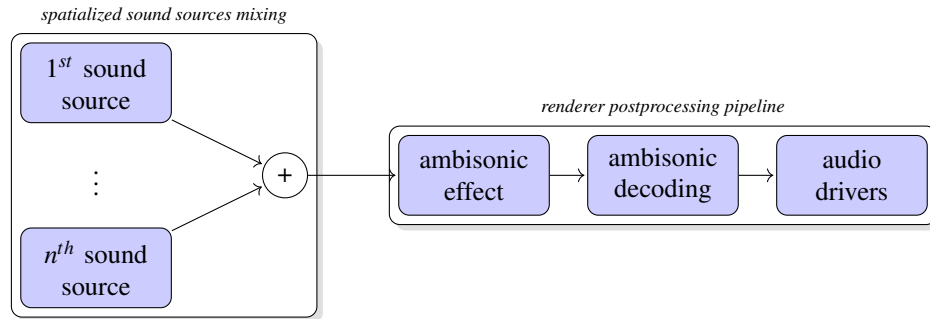


Figure 3: Audio computation pipeline

adapted to several kinds of audio displays. Being a SuperCollider Quark (the SuperCollider extension format), SATIE is easy to deploy.

SATIE can be controlled directly through SuperCollider language or using its OSC [8] protocol. We prefer to control it with 3D engines (Unity 3D, Blender). A generic python module is underway which, we hope, will simplify integration with other tools, including Panda 3D engine [9].

In order to render binaural audio for the stereo image required by the MyBeam speaker array, we implemented an audio rendering that incorporates ambisonics for panning. We included ambisonics decoders and effects in our renderer postprocessing pipeline (see Figure 3), allowing for sound sources to output to a unique binaural decoder configured for a particular speaker orientation. We have found that a third order ambisonics implementation offers a reasonable spatial resolution.

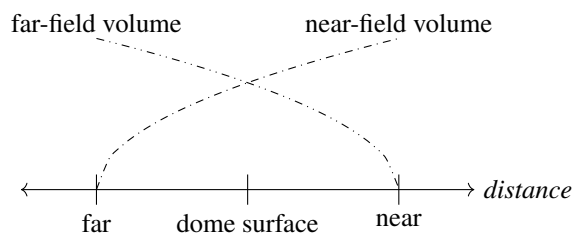


Figure 4: Crossfade between volumes of the two renderers. Since sound source volumes are computed by each renderer, a crossfade is applied (per sound source) in order gracefully transition between displays when the trajectory crosses the dome.

3 Prototype design and description

At the aforementioned 2017 IX symposium, our prototype consisted of a combination of two different audio displays: the Satosphere and several Wave Field Synthesis (WFS) bars, as illustrated with Figure 5. For this presentation we used the dome’s standard 32-channel speaker configuration

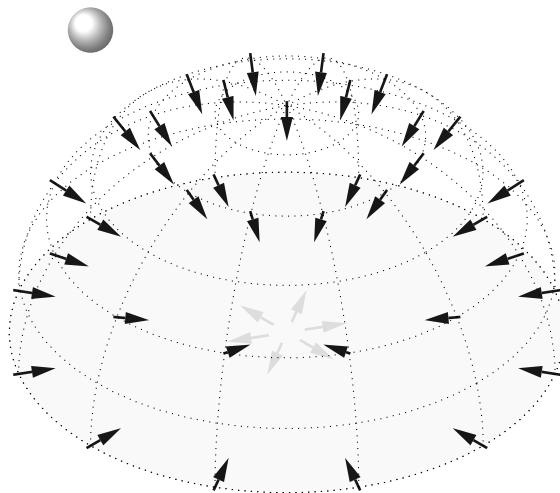
for the far-field display, while for the near-field display, we rigged the center of the dome with a ring of 8 MyBEAM binaural speakers, each at standing height and oriented outwards horizontally, at intervals of 45 degrees (e.g. N, NE, E, SE, S, SW, W, NW). We opted to use two instances of SATIE running on two different computers, one for each display. The two instances were rendering identical audio scenes controlled by one instance of an interactive 3D scene, projected on the dome. The listening perspective rotation corresponding to each binaural near-field display had to be computed according to its physical (MyBEAM) speaker position within the space.

The VLP is located in the center of the 3D scene (center of the dome) and the audio display’s cross-fade coefficient is calculated, per sound source, according to its distance from the VLP in the audio scene. We tune an exponential function “by ear” in order to obtain the most natural sounding and “seamless” transition between far field and near field, as illustrated in Figure 4. With the ability to compute binaural localization cues for near-field sound sources, and the ability to deliver binaural rendered audio to listeners in the dome without the need for headphones, we are able to focus on tuning the hybrid system to ensure that approaching and retreating sound sources transition smoothly between the near-field and far-field audio displays.

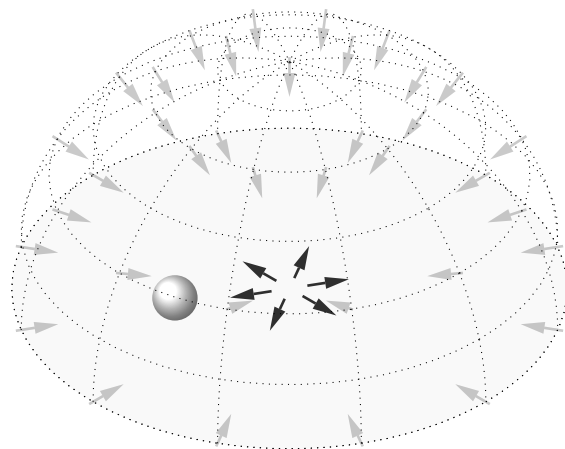
Thus, our prototypical hybrid system combines two audio renders: A and B; both render the same audio scene containing a single VLP and several nearby and distant sound sources. Renderer A renders sound sources very near to the VLP, while B renders the remaining sounds. The renders’ outputs are diffused and combined within the same listening space. Care is taken to ensure that each system’s speaker configuration is properly oriented with respect to the audiocenter, to ensure a coherent combined aural image.

Our hybrid near-field/far-field system defines the following:

- the “near field”: the space surrounding the VLP, at the center of which sound sources will only be rendered to the near-field audio display



(a) The virtual sound source is located outside the dome: it is visible on the dome display and can be heard through the dome sound system.



(b) The virtual sound source is located inside the dome: it is not visible in the dome display, but can be heard through the WFS sound system located at the center of the dome

Figure 5: Illustration of a single sound source (the sphere) rendering when crossing the dome-shaped display. Arrows show the locations and orientations of the speakers of each display.

- the “near field radius”: a distance from the VLP, beyond which sound sources will only be rendered to the far-field audio display.
- the “transition region”: the space between the near-field radius and the VLP in which sound sources will be rendered to both near and far-field audio displays, using a cross-fade operation to determine for a given source the amount of its energy sent to each display.
- the “cross fade exponent”: a value to change the quality of the cross fade operation, allowing for empirical tuning of sound source transitions to and from the near-field.

Thus, if a given sound source’s distance to the VLP is less than the “near-field radius” length, its output is cross-faded between the two audio display systems because the sound source is within the “transition region”. In such a case, if the value of the “cross fade exponent” is equal to one, the cross-fade will be linear, proportional to the distance divided by the near-field radius, otherwise it will produce a non-linear cross-fade that either augments or reduces the amount of sound source energy in the near field, based on that distance. Ideally, we would like for the perception of the cross-fading between the two audio display systems to be as continuous and transparent as possible. By adjusting the “near field radius” and the “cross-fade exponent” parameters, we can make improvements towards that end.

4 Conclusion and future works

We have prototyped a hybrid immersive environment with simultaneous rendering of the same audio scene graph for two audio displays: a far-field 31 channel dome, and six independent binaural WFS speaker arrays producing a coherent near-field stereo image to several listeners without headphones. The prototype implementation included a virtual 3D scene containing virtual sound sources moving towards and away from the virtual listening position at the dome’s center. The far-field and near-field zones were computed by two separate SATIE renderers, managing respectively, the dome audio display and the six MyBeam speaker arrays located at the center of the dome. To ensure that the energy of the sound sources in the virtual scene is distributed evenly across the two audio displays, we implemented a source specific amplitude crossfade between both renderers, based on each source’s distance to the virtual listening position, using a near-field radius that corresponds approximately to the distance from the dome’s center to its speakers).

The demo during the IX symposium demonstrated the viability of our prototype: we had the opportunity to hear virtual 3D scenes with sound source trajectories that pass inside and outside of the dome. Subjectively speaking, we would say that the crossfade between the two renderers that we developed is sufficiently “graceful” and “natural” so as to go largely unnoticed. The demo was easily mounted within few hours, the main challenge was the calibration of the cross-fade between renderers.

We are optimistic about the ability to apply our experiences with the prototype to the creation of impromptu (spon-

taneous) immersive environments with hybrid audio displays combined with video mapping, AR headsets, or others. We are particularly interested in the application of near-field / far-field rendering techniques in the context of multi-user Augmented Reality applications, in which, user-specific mobile audiovisual displays can uniquely render local audio content within an “arm’s reach” of the user, extending the range of interaction to include the fine and intimate space surrounding him/her. Finally, in future work, we intend to investigate the use of other audio displays and automation of the calibration process for hybrid setups, possibly involving mobile listeners.

Acknowledgement

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