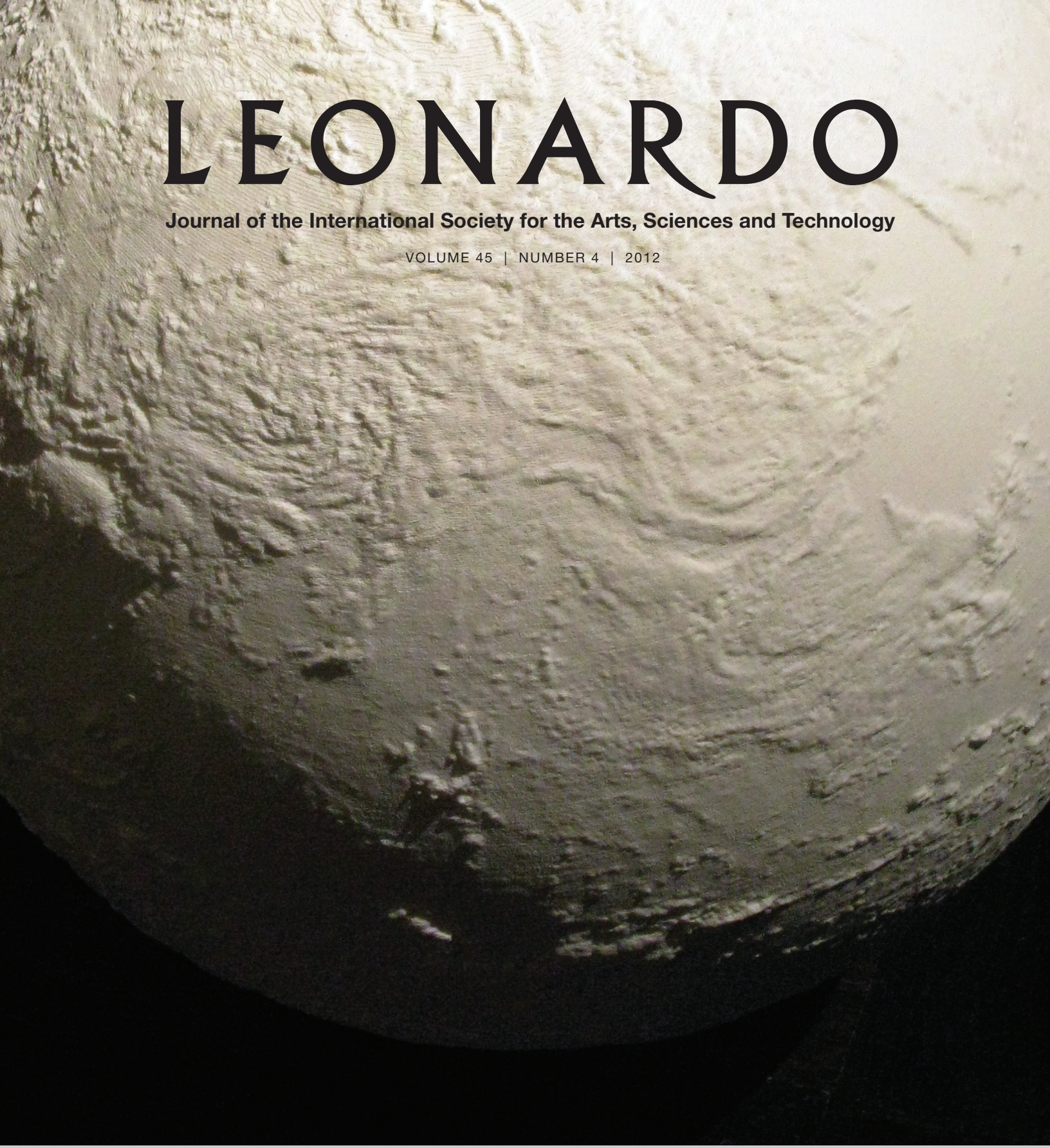

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# LEONARDO

**Journal of the International Society for the Arts, Sciences and Technology**

VOLUME 45 | NUMBER 4 | 2012


## LEONARDO SPECIAL ISSUE: SIGGRAPH 2012 Art Papers and In Search of the Miraculous Art Gallery



*Front Cover*
*A Planetary Order* is a terrestrial globe showing clouds from one single moment in time (2 February 2009 at 0600 UTC precisely), thereby subtly highlighting the fragility and interdependence of the Earth's environmental systems. Material: SLS Nylon. © 2010 Martin John Callanan.

*Back Cover*
*Shadow Worlds | Writers' Rooms [Brontë Parsonage] No.6*, 2011. Digital print on Hahnemühle Photo Rag, 70cm x 1m. The artists, working with hand-made masks and props, improvise roles to create shadow tableaux to be photographed. The resulting images allude to "a scene unseen" outside the frame of the final image. © 2011 Brass Art. Photo © 2011 Simon Pantling.

# Guest Editorial

Mine Özkar

The annual SIGGRAPH conference has been consistent in presenting juried artwork since 1982. This tradition has prompted a steady appearance of art-based scholarly research at the event, and in 2008 the conference added Art Papers to its art programs while renewing the collaboration between ACM SIGGRAPH and Leonardo/ISAST. Since then, the 2009, 2010, and 2011 Leonardo/ISAST Special Issues have expanded our capacity to attract, review, and publish the state of the art in digital art and design.

This year marks the 30th anniversary of SIGGRAPH Art Gallery (In Search of the Miraculous, here introduced by Osman Khan) and the fourth edition of SIGGRAPH Art Papers. We take great pride in bringing you five new art papers that demonstrate compelling art and design practices in solid conceptual frameworks.

Perhaps the most exciting interchange at SIGGRAPH is in the conversations among specialists of diverse talents and skills at the convergence of art and science. Building on this long tradition of talking and sharing, Art Papers inform and set standards for critical analysis and research in digitally mediated art. Even more importantly, as articulated narratives that draw connections to social, cultural, aesthetic, intellectual, and technical contexts, Art Papers enhance the value of the thoughtful processes and innovative techniques behind the works and add to the understanding and appreciation of their practical and theoretical contributions to the community.

For SIGGRAPH 2012, the Art Papers program called for submissions in any one of these categories: Project Description, Position Paper, Thematic Survey, Technical Paper, Design Methods, or Monograph. The jury deliberations revealed that, to a positive effect, these categories often merged. Most submissions focused on project descriptions but also appeared as position papers, included thematic surveys that establish historical and theoretical context, or provided technical and methodological details. The selection discloses this tendency. All papers featured in this issue illustrate a practice or a position. They do so within the context of prior work while providing technical or methodological insights and embodying a strong artistic point of view. From paper to paper, the focus shifts among the product, the process, and the theory. This year, the Art Papers jury procedures once again modeled the Technical Paper's protocols, which set a high standard in peer review. Each submission was reviewed in great detail by at least four experts. Out of the 55 submitted manuscripts, five were accepted, for a ratio of 1:11.

I would like to extend my sincere thanks to the Art Papers Committee, over 40 reviewers, the Art Papers Advisory Board, SIGGRAPH contractors, our colleagues at Leonardo, and the authors, without whom the fourth SIGGRAPH Art Papers would not have been possible.

Mine Özkar
ISTANBUL TECHNICAL UNIVERSITY

# Conference Art Communities Director's Statement

Elona Van Gent

The SIGGRAPH conference has long held a highly respected position as the place where leading researchers meet and share ground-breaking developments in computer graphics and interactive techniques. It is a not-to-be-missed annual highlight for those engaged in these fields. The same has been true, but to a lesser degree, for artists and scholars who work with digital and interactive media. So five years ago, following the lead of artist Rebecca Strzelec, a collective decision was made to expand the role of art and design scholars and practitioners by renewing a commitment to the existing SIGGRAPH art programs, the Art Gallery and Studio, and adding a third program, Art Papers. The benefits of that decision are increasingly apparent.

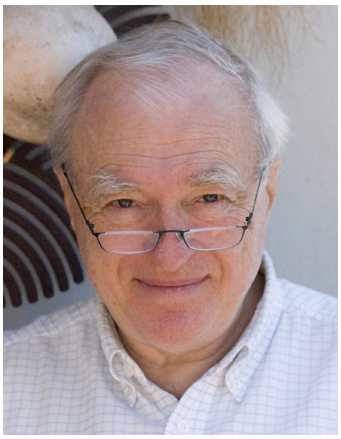
For the 2012 conference, the Studio, under the leadership of Makai Smith, again offers a hands-on creative space for art and design of all kinds. It is a collaborative working environment where the latest technologies and brightest minds come together to learn, experiment, and create. New to the Studio is the inclusion of juried panels and presentations related to the creative design and production side of digital technologies. The Art Gallery contributes to the conference by inviting creative practitioners from around the world to submit their work for review. The gallery's focus this year, chosen by the Art Gallery Chair, Osman Khan, is wonderment – artworks that both inspire and are inspired by moments of awe, surprise, and wonder. Of the nearly 400 projects submitted this year, 12 were selected for the Art Gallery. They are also documented here in the SIGGRAPH Special Issue of *Leonardo*.

Which brings us to the newest SIGGRAPH art program, Art Papers, and to the wonderful collaboration that results in the journal you hold in your hand. Art Papers, now part of the conference for the fourth year, are scholarly papers that illuminate and explore the changing roles of artists and the methods of art-making in our increasingly networked and computationally mediated world. Art Papers chosen by the review committee are presented at the conference by the authors and published in a special SIGGRAPH issue of *Leonardo, The Journal of the International Society for the Arts, Sciences and Technology*. This publication is a collaborative endeavor among MIT Press, Leonardo/The International Society for the Arts, Sciences and Technology, and ACM SIGGRAPH. We are grateful for the opportunity to work with these partners and very proud of the outcome. The publication is a tangible indicator of the commitment all three partners have made to supporting and providing opportunities for professionals who are actively engaged in scholarship and creative work in art and technology.

Elona Van Gent
UNIVERSITY OF MICHIGAN

# ACM SIGGRAPH Distinguished Artist Award for Lifetime Achievement in Digital Art

Jean-Pierre Hébert



**Jean-Pierre Hébert. Photograph courtesy of Elaine Levasseur.**

The 2012 ACM SIGGRAPH Distinguished Artist Award for Lifetime Achievement in Digital Art is awarded to Jean-Pierre Hébert for his pioneering achievements in creating art through computer programming. At the core of his work are algorithms that generate drawings on paper, as well as in sand and other mixed media. Hébert began working with digital conceptual algorithmic art in 1974 and has been an independent artist since 1984. Since 1989, his work has appeared in 17 SIGGRAPH Art Galleries. In 1995, he co-founded The Algorists with Roman Verostko, a group that eventually included Hans Dehlinger, Helaman Ferguson, Manfred Mohr, Ken Musgrave, and Mark Wilson. He was appointed Artist in Residence at the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara (UCSB), in June 2003. He has received grants from the Pollock-Krasner Foundation (2006) and the David Bermant Foundation (2009). His aesthetic is based on a patient, evolving exploration of the line. He looks at drawing not as gestural, but more essentially as a direct expression of thought that might be inspired by or suggestive of motion, time, music, light, logic, nature. Technically, his work rests on simple coding informed by geometry, mathematics, physics, and great attention to rendering details. He also explores chaos and order, silence and sounds, music, text, poetry, and the ephemeral. Some of the ideas and concepts he incorporates into his work stem from Zen Buddhism and his spiritual approach to life.

The first public exhibition of his digital drawings was in France in 1989 at the Galerie Alphonse Chave in Venice. His work has also been included in several other landmark exhibitions: Alien Intelligence at the Kiasma Museum of Contemporary Art, Helsinki, Finland, in 2000; Drawing with the Mind at the Santa Barbara Contemporary Arts Forum; Imaging by Numbers at the Block Museum of Art, Chicago, in 2008; Digital Pioneers at the Victoria & Albert Museum, London, in 2010; and Drawing with Code at the deCordova Museum in 2011. Additional selected venues have included the Kavli Institute of Theoretical Physics, the Brooklyn Museum, the Santa Barbara Museum of Art, the Tweed Museum, the Getty Research Institute, the New York Drawing Center, and [DAM] (Berlin, Cologne). Hébert has resided in Santa Barbara, California, since 1985, and, in addition to international exhibitions, he shows in Santa Barbara and Los Angeles venues and galleries.

Jean-Pierre Hébert is active as a public speaker and advocate for digital art and algorithmic methods of creating art. He has participated in SIGGRAPH panels in 1995, 1998, and 2005; the UCSB Art Symposiums in 1999 and 2007; and in forums and symposiums at Pratt Institute, the University of California, Los Angeles, the University of Chicago, Rhode Island School of Design, Pasadena Art Center College of Design, the Southern California Institute of Architecture, and many other conferences and events. ACM SIGGRAPH is honored to recognize Jean-Pierre Hébert. He is one of the pioneers who have led the way toward new forms of creative expression using digital techniques and algorithms. His consistent record of art production, exhibiting his work, and public speaking as an advocate of digital art make him an exceptional individual in the field.

**Ronen Barzel**
Ronen Barzel, previously an animation scientist at Pixar Animation Studios and senior technologist at Adobe Systems Incorporated, is currently CTO of Musemantik, Ltd. He was SIGGRAPH 2009 Conference Chair and SIGGRAPH 2004 Sketches Chair, and he created the SIGGRAPH Posters program. He served as editor-in-chief of the *Journal of Graphics Tools* for over a decade and was co-editor of the Audio Anecdotes series of books on digital audio. His visiting academic positions include teaching at the University of Washington, the Massachusetts Institute of Technology, the École Polytechnique, and the University of California, San Diego. He holds a BSc in math and physics and an MSc in computer science from Brown University, and a PhD in computer science from the California Institute of Technology.

**Onur Yüce Gün**
Onur Yüce Gün is an architect and computational design specialist. He is currently a Presidential Fellow at the MIT Department of Architecture, where he is pursuing his PhD in design and computation. His work and teaching focus on computational and generative design processes and methodologies. He initiated and directs Kohn Pedersen Fox Associates New York's Computational Geometry Group. He has been an invited critic at Harvard University, MIT, the University of Pennsylvania, Columbia University, the University of Illinois at Chicago, Middle East Technical University, Istanbul Technical University, and Yildiz Technical University, and he has conducted numerous workshops in Europe and the US. He instituted and coordinated the core first-year design and geometry courses in the undergraduate design program of Istanbul Bilgi University. He holds a SMArchS Computation degree from MIT and a B.Arch. from METU, and continues architectural design practice under his Computational Design Collaboration initiative, O-CDC (o-cdc.com).

**Tad Hirsch**
Tad Hirsch is an assistant professor in the Divison of Design at the University of Washington School of Art, where his research interests lie at the intersection of design, urban space, and collective action. He was previously a senior research scientist at Intel Labs and a member of the Rhode Island School of Design Digital + Media faculty. He is a founding member of the Institute for Applied Autonomy, an internationally recognized art/technology/activism collective. His creative work has been included in festivals and exhibited in museums and galleries throughout Europe and America, including the ZKM, Ars Electronica, The New Museum, The Aldridge Museum of Contemporary Art, and MassMoca. His research has been presented at ACM conferences and in edited volumes published by MIT Press and Routledge. He holds PhD and MSc degrees in media arts and sciences from MIT and an MDes in interaction design from Carnegie Mellon University.

**M. Nyssim Lefford**
From hardware to wetware, M. Nyssim Lefford has sought to understand how creators create, to find ways to facilitate the creative process, and to uncover the potential in new technology and new perspectives to shape what is created in the future. Her investigations have ranged from record production to installation art to music cognition research. She received her PhD and MS from MIT's Media Lab, and her Bachelor's of Music in music production and engineering and film scoring from Berklee College of Music. She has taught at the Georgia Institute of Technology and at Luleå University of Technology.

**John Marshall**
In 1998, John Marshall co-founded rootoftwo, a hybrid art and design studio that makes experimental objects and spaces that seek to challenge perceptions, expectations and established behavior. Marshall is an assistant professor at the School of Art & Design and has a courtesy appointment at the Taubman College of Architecture and Urban Planning at the University of Michigan. He earned a PhD from Robert Gordon University, where his dissertation explored the impact of digital design and fabrication tools on hybrid art and design practice. Marshall regularly serves on the advisory boards and programming committees of conferences related to the intersection of art, design and technology.

**Mine Özkar**
Mine Özkar is an associate professor of architecture at Istanbul Technical University, where she also serves on the executive committee for the Program in Computational Design. She earned her MS in design inquiry and her PhD in design and computation from MIT. In some of her previous work, she has interpreted the history and theory of progressive pedagogy in art and design from a computational perspective. Her current research focuses on shape representation, spatial computation, and computational design methods. She also publishes on the theory and practice of foundational design education and the ongoing global and local curriculum reforms in architectural education.

**Teri Rueb**
Teri Rueb is a professor in the Department of Media Study at the University at Buffalo (SUNY), where she is founder and director of the Open Air Institute. She is widely considered to be a pioneer in the field of locative media. Her work has been funded with grants and commissions from the Banff Center, Edith Russ Site, Santa Fe Art Institute, Klangpol, La Panacée, LEF Foundation, Turbulence.org, and Artslink. She has exhibited her work worldwide at festivals including SIGGRAPH, Ars Electronica, ISEA, and Transmediale. She received an Award of Distinction from Prix Ars Electronica in 2008 and is a CalArts Alpert Award Nominee for 2012. From 2004–2009 she was founding faculty and later Department Head of Digital + Media at the Rhode Island School of Design. Rueb holds a doctorate from Harvard University, a master's degree from New York University (ITP), and a bachelor's degree (honors) from Carnegie Mellon University.

**Victoria Szabo**
Victoria Szabo is an assistant research professor at Duke University, where she focuses on visual studies and new media. She is also the director of the interdisciplinary program in Information Science + Information Studies, and co-directs the Franklin Humanities Institute's GreaterThan Games. Her work focuses primarily on spatial media and archives for purposes of historical and cultural representation and interpretation. She has been involved in the SIGGRAPH arts community for several years as a juror and committee member for the Art Gallery and Art Papers. She was the chair of the Information Aesthetics Showcase in 2009 in New Orleans and will chair the SIGGRAPH Art Gallery in 2013 in Anaheim. She also spent several years as an academic technology developer at Stanford University and holds a PhD in English Literature and Culture from the University of Rochester.

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# Art Papers

# *Translation* + Pendaphonics = Movement Modulated Media

Byron Lahey, Winslow Burleson, Elizabeth Streb

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**ABSTRACT**

***Translation* is a multimedia dance performed on a vertical wall filled with the projected image of a lunar surface. Pendaphonics is a low-cost, versatile, and robust motion-sensing hardware-software system integrated with the rigging of *Translation* to detect the dancers' motion and provide real-time control of the virtual moonscape. Replacing remotely triggered manual cues with high-resolution, real-time control by the performers expands the expressive range and ensures synchronization of feedback with the performers' movements. This project is the first application of an ongoing collaboration between the Motivational Environments Research Group at Arizona State University (ASU) and STREB Extreme Action Company.**

## Introduction

*Translation* (aka *Run Up Walls*) is a multimedia performance in which dancers explore movement possibilities availed by the low-gravity environment of the lunar surface. Realizing this experience does not require a mission to the moon. Instead, the dancers ascend a vertical wall with the assistance of custom-designed harnesses and rigging. A video projection fills the wall with a lunar surface that moves and rotates in response to the dancers' movements. A musical soundtrack composed by David Van Tieghem amplifies the atmosphere and augments the sound of the dancers as they walk, run, leap, tumble, and slam into the surface of the wall.

**Figure 1. Performers falling face-forward toward the wall after executing a synchronized leap. The projected lunar surface, visible on the wall, zooms in and out based on the performers' distance from the wall. Image captured from video documentation of performance. © 2009 Elizabeth Streb.**

 © 2012 Byron Lahey, Winslow Burleson, Elizabeth Streb | Leonardo, Vol. 45, No. 4, pp. 322–329, 2012

### Background

F.A.R. (Future Arts Research at Arizona State University) director Bruce W. Ferguson explains the program's mission:

> F.A.R. has initiated a new model for arts institutions by supporting artists whose "action research" generates new forms of knowledge, using one of our specific areas which resonate with the Phoenix community [1].

F.A.R. sponsored and organized an exploratory visit to connect the STREB Extreme Action Company with the Motivational Environments Research Group at ASU to plan the nature of shows, venues, production logistics, speaking engagements, and community outreach events. A meeting was held in which members of our research group met with performance organization principals and discussed their research agendas. A deep and synergistic excitement emerged from the mutual philosophy of learning by doing, rapidly prototyping solutions, and going beyond what is currently possible, linking science, engineering, art, and human experience with interaction design and dance. Plans soon evolved to form a close collaboration that has extended for the past three years. Discussions of a wide range of sensing technologies and interaction modalities were advanced, iterations of wireless magnetic sensors were explored to trigger sonic events, discussions of more robust motors and bearings for one of the performance company's existing dance apparatuses were had. A rich series of meetings, prototyping sessions, and improvisations, involving dancers, engineers, artists, musicians, and graduate student visits to the STREB Lab for Action Mechanics in Brooklyn, New York, and workshops at an ASU theater ultimately led to the project described herein, which was one of the pieces for the STREB Extreme Action Company's subsequent touring show.

### *Translation* Background

*Translation* is one of many performances created by Elizabeth Streb's company that explores human movement with physical apparatuses that generate forces and provide obstacles and opportunities for movement that has more in common with circus acrobatics than traditional dance on a flat stage. Dancers performing *Translation* wear harnesses that allow them unrestricted rotational movements while being lifted off the ground. The rigging from the top of the wall to the harnesses places the anchor points at the top of the wall such that when the dancers' bodies are parallel to the floor with their feet on the wall, there is minimal force between the dancers' feet and the wall. In this configuration, the wall becomes the floor for the dancers, with a simulated gravitational force that is proportional to the dancer's distance from the wall (Figures 1 and 2).

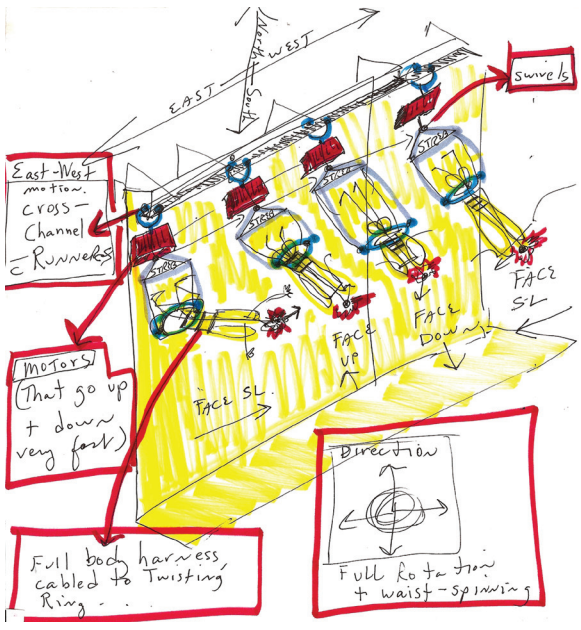


**Figure 2. This early conceptual sketch of *Translation* shows the performers in relation to the required hardware that supports this performance. © 2009 Elizabeth Streb.**

### Pendaphonics Background

Dan Overholt, Anne-Marie Skriver Hansen, Winslow Burleson, and Camilla Nørgaard Jensen invented

Pendaphonics for an interactive art installation in 2008 [2]. Pendaphonics is a combination of hardware and software that allows physical pendulum devices to control audio, video, and other actuators based on the movement of the pendulum bob.

The first performance of Pendaphonics took place at Platform 4 gallery in Ålborg, Denmark, and featured eight Pendaphones (interactive pendulum devices) (Figure 3). Visitors were invited to collaboratively activate the art and performance space, both sonically and visually, by manipulating the pendulums. The natural periods of the pendulums provide rhythmic consistency when they are allowed to swing or orbit freely, but no constraints were placed on the nature of the interactions. Participants could freely move the pendulum bobs by hand, pluck on the string like a bass, or pass it back and forth with their friends. This empowered participants to create a sonic environment that was as ordered and sparse or chaotic and dense as they collectively desired.

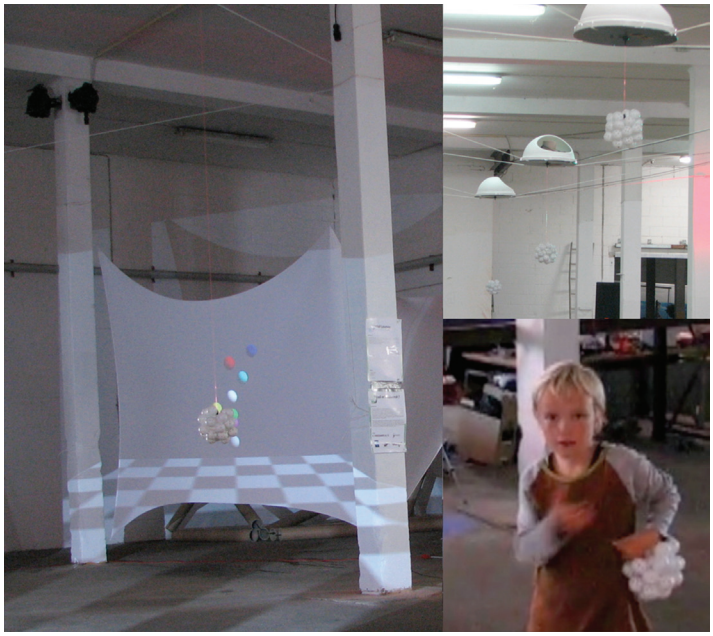

**Figure 3. Pendaphonics interactive art installation at the Platform 4 gallery in Ålborg, Denmark. Five Pendaphones are visible; one is being "plucked" by a boy. A video projection shows the positions and movements of all the pendulum bobs. © 2008 Dan Overholt.**

Pendaphonics has subsequently been used for research and art installations at numerous institutions, including Ålborg Universitet, Arizona State University, and the University of California, Berkeley [3]. Its uses have included mathematics education, laptop orchestra performances, position tracking for robot navigation, and additional interactive art installations, including one at the New Interfaces for Musical Expression (NIME) conference [4]. Pendaphonics is formally documented in Hansen et al.'s 2009 Tangible and Embedded Interaction paper [5]. Freed et al. provide extensive documentation of artistic applications of the Gametrak, including Pendaphonics [6].

## Pendaphonics System

The Pendaphonics system includes modified off-the-shelf hardware and custom software.

### *Pendaphonics Hardware*

The base hardware for the Pendaphonics system is a game controller called the Gametrak [7] (Figure 4). Though no longer in production, the Gametrak remains useful for human-computer interactions beyond the scope of its original design purpose. Gametrak controllers have a simple but very effective mechanism for tracking two points in 3D space. The device uses a small two-axis joystick for each tracked point. As with traditional joysticks, these provide two degrees of freedom (X and Y rotational angles). The third degree of freedom (Z distance) is achieved by sensing the motion of a thin, retractable nylon string that pulls out from the end of the joystick. Electronically, the positions are sensed by the rotation of potentiometers that provide variable voltage to an analog-to-digital converter. The data are formatted by an embedded

microcontroller (with a small modification to the board), which provides the data to a computer via USB as a standard human interface device (HID). Depending on the number of devices to be used and their spatial configuration, it is sometimes more efficient to consolidate the output of several Gametrak sensor sets into a third-party microcontroller. In some cases, the original controller packaging works perfectly well, while in other cases, for compactness, specific functional requirements or aesthetics, we have transferred the essential sensing hardware into custom enclosures.

**Figure 4. The Gametrak video game interface in its unmodified form. The two "joystick" connectors visible on the top of the interface pull out and retract allowing the hardware to provide 3D position information for two tracked points. This interface foreshadowed full body motion interfaces such as the Nintendo Wii, Microsoft Kinect and Playstation Move. © 2009 Byron Lahey.**

The sensing space for the original Gametrak controller is a cone with a side length of approximately three meters and a total angle of approximately 80 degrees (40 degrees in each direction from perpendicular). For use in the *Translation* performance, this sensing space was not sufficient. The length of the retractable string had to be extended to approximately nine meters. Replacing the original coil spring retraction hardware with another from a modified tape measure, replacing the original potentiometer with a multi-turn potentiometer, and substituting a longer nylon string accomplished this (Figure 5).

**Figure 5. Extended-range Pendaphone hardware attached above the performance wall. The line from the Pendaphone connects to the rigging used by the performers to ascend the wall. The larger retraction spring in the tape measure replaces the smaller original spring in the Gametrak, allowing the Pendaphone to track 3D motion from floor to ceiling. © 2009 Byron Lahey.**

### *Pendaphonics Software*

The raw data from the Gametrak controller can be read as a standard HID. The analog-to-digital conversion is 12 bit, providing values for X, Y and Z ranging from 0–4095. We use custom Max [8] software to process these data and translate them into meaningful feedback. This software varies significantly depending on the specific application. For the *Translation* performance, the raw data are received in Max, normalized and filtered, then sent via UDP network connection to a secondary show-control computer running custom Open Frameworks (a C++ toolkit) [9] software to control parameters of the visualization. This software is further explained in the System Architecture section.

## Augmenting *Translation* with Pendaphonics

The previous sections have provided background information on the *Translation* performance and have covered technical and creative aspects of the Pendaphonics system. The following sections will go into more depth on the integration of these two projects.

### Motivation and Benefits

For the first generation of *Translation*, the medium was entirely cued and controlled manually, by technicians pressing computer keys. While this system worked, it was not able to fully capitalize on the affordances of the interactive 3D program generating the visual feedback. With manually activated triggers, the system could only produce predefined movements, such as a large or small leap off of the lunar surface. With the Pendaphonics sensor system, the program can provide visualizations, in real time, that correspond directly to the continuous movements of the dancers. The effect of transferring significant parts of the show control from a technician to the dancers did not, and was not intended to, change the choreography of the performance. The performance retains the same movements, scene shifts, and timing, but several key improvements were immediately obvious. The chance of a cue being triggered at the wrong time, while rare with manual control, was essentially eliminated. The high-resolution position sensing allowed the magnitude of the dancers' movements to be matched with perfectly scaled movements of the projected ground under their bodies. The sensor control allowed the show technician to focus on other aspects of the presentation.

### Pendaphonics Versus Alternative Motion Capture Technology

The team working at the STREB Lab for Action Mechanics (SLAM) had long considered the benefits of integrating motion sensing with their multimedia dance performances. Surfaces are often outfitted with microphones to amplify the acoustics of the bodies that impact them. Elizabeth Streb has compared the use of physical apparatuses for expanding the range of human movement with the use of musical instruments to augment the human voice [10, 11]. Technology, especially in the form of mechanical inventions, is integral to the vision of this performance group. The reason for not including motion sensing has not been ideological. It has been purely practical. Optical motion capture was not considered viable for several reasons. The complex visual environments that include performance apparatuses, video projections, and the presence of audiences and support technicians in unpredictable locations make the occlusion of tracking markers extremely likely. Physical markers would create pressure points incompatible with the nature of the actions of the dancers and would be difficult or impossible to keep in place. Calibration requirements would be too time-consuming for live and traveling performances. Markerless optical systems are even more sensitive to environmental variables. Beyond these technical obstacles, full-blown motion capture systems optimized for special effects production and research activities provide much more data than what is required for this application.

While a comprehensive survey of alternative human interfaces and motion tracking systems is beyond the scope of this paper, a few interesting, related alternatives should be noted. Kaufman presents a mechanically linked, harness-based motion capture system targeted at military virtual reality training applications [12]. This system would not match the low encumbrance requirements for the STREB performers. Yang and Pai discuss the use of a harness outfitted with load cells [13]. In their research, the application automatically detects slips for use in movement therapy. While this is a significantly different application area, the availability of force sensing in the performers' harnesses could expand the creative potential of our system. Char Davies' *Osmose* [14] used a Polhemus Fastrak [15] sensor to measure position and orientation, and a custom vest/harness to measure the expansion and contraction of the wearer's chest. The Polhemus system costs around $6,000, so while this sensor could technically be a viable alternative, it would be much more expensive. The approach used to sense breathing in *Osmose* is an interesting one to consider for future collaborations with STREB, but it would require carefully designed wearable hardware for the extreme demands of the performers.

The Pendaphonics system was a natural fit for this particular performance, as the dancers are suspended in harnesses (see Figure 6) and effectively become pendulums. The Pendaphone hardware allowed us to track the dancers' movements in three dimensions as they traveled up and down the wall. The Pendaphone hardware, being based on a commercial game interface, is designed to be simple, low cost and very robust. Since the sensing is mechanical, visual occlusions and complexity are not relevant, and radio-frequency interference is never an issue. Pendaphonics has no encumbering effects on the dancers, enhances the expressiveness of the visual feedback system, and reduces the workload of the show technicians during live performances.

**System Architecture**

The integrated *Translation* and Pendaphonics system includes:

**Figure 6. Custom harnesses that allow for free rotation about the torso and rigging line axes. These harnesses, similar to those used for special effects stunt-work, allow the performers to flip, twist, and move freely across the wall. © 2009 Elizabeth Streb. Photo © 2009 Byron Lahey.**

- 25-foot-tall vertical wall
- Custom harnesses that allow rotation on the torso axis
- Swivel connectors allowing rotation on the support cable axis
- Steel cable rigging line from the harness to the anchor point
- Electric motor winches to lift and lower dancers
- Pendaphonics hardware with line connected to rigging cable
- Laptop computer running Max Pendaphonics software
- Main show-control computer running Open Frameworks *Translation* visualization software
- Ethernet cable connecting Pendaphonics computer and show-control computer
- Audio-cue computer and PA system
- Video projector
- Three performers
- Technical support staff to supervise and run computers and motors, and assist performers

Aaron Henderson programmed the visualization of the lunar surface using the Open Frameworks C++ toolkit. This visualization has a spherical object mapped with an image of the moon's surface. This sphere can be rotated in any direction at any speed and can be oriented to and positioned at any distance from the virtual camera. This control allows the performers to walk

on the real floor towards the wall with an image of the moon very low on the horizon. As the performers transition from standing on the floor to walking up the wall, the virtual moonscape gradually shifts to a top-down view, so it appears that the dancers are walking on the surface of the moon and are being seen from overhead. When the dancers leap off the wall, the virtual distance to the moon is increased. This virtual distance is increased in an exaggerated scale, giving the optical impression of extremely large leaps. As the performers move toward one side of the wall, the moonscape rotates under their feet (as a treadmill would). Exaggerated rotational speeds are used expressively to give the illusion of very fast motion. Control of these visualization parameters is split between manually triggered cues and real-time Pendaphonics-driven modulation. Manual cues are used for major scene transitions (for example, when the performers transition to and from the wall) and when real-time sensing is potentially incongruous with the desired feedback for a particular section. Real-time Pendaphonics control can be manually overridden in such cases.

### Project Outcome

"The idea of taking mechanization, and taking robotics, and taking machines, and mixing them with human movement potential, and space and time, is really what the whole category of investigation is about" [16]. Elizabeth Streb states: "I think that people ignore and don't perceptually notice movement" [17]. Streb describes the importance of having microphones positioned everywhere to allow the audience to hear the impacts of bodies against floors, walls, and performance apparatuses. The idea is to convey the substantiality of these impacts to the audience. The Pendaphonics system serves the same conceptual function as the microphones: amplifying a signal (in this case motion) to make it more perceptible to a large audience viewing the performers' movements at a distance. Streb suggests that this amplified movement induces a feeling of vertigo in the audience. Streb, the production staff of Streb Extreme Action Company, and the Pendaphonics creators viewed the integration of the Pendaphonics system with the *Translation* performance as a great success. With this system, the dancers had direct control of key visual feedback parameters. This transfer of control improved the expressive range of the feedback by providing real-time position control of the virtual height and rotation of the lunar surface.

This project served as a proof of concept of the effectiveness of using low-cost sensors and custom software to sense the motion of dancers and performance apparatuses in a challenging environment. This sensing can enhance control of existing feedback and allow for the creation of new data-driven media that can reveal additional forces and actions, expanding the creative palette of the artistic director.

For this iteration of the project, a single Pendaphonics sensor connected to a single performer was used as a simple resolution to the problem of potentially conflicting data when, for example, one performer made a big leap while the other two remained close to the wall. For future iterations, all the performers' positions will be monitored and a more sophisticated algorithm will be generated to selectively average, filter, and prioritize sensor data for particular segments of the performance.

### Opportunities

While working on the integration of Pendaphonics with *Translation*, we experimented with using Nintendo Wii Remotes [18] to measure the acceleration of spring boots worn in another performance. The wireless data from this type of sensor could enhance the perceptual experience of this performance by revealing the forces involved. Of particular interest might be the moments of zero gravity at the apex of leaps or the distinct data patterns created when the performers do

flips. Feedback from these data could be in the form of audio, projection of light, or any other computer-controlled form. The application of real-time sensing need not be limited to audio and visual feedback. Physical actuation of performance apparatuses based on real-time sensing would open up new movement experiences and choreographic opportunities.

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**References and Notes**

1. F.A.R. @ ASU: Future Arts Research at Arizona State University, futureartsresearch.asu.edu/, accessed March 21, 2012.
2. A. Skriver Hansen, Pendaphonics installation at Platform4, 2008, www.platformart.net/pendaphonics_demo.htm, accessed March 21, 2012.
3. A. Schmeder, A Portable Pendaphonics Rig, cnmat.berkeley.edu/user/andy_schmeder/blog/2009/05/31/portable_pendaphonics_rig, accessed March 21, 2012.
4. D. Overholt, et al., Pendaphonics, art installation at the International Conference on New Interfaces for Musical Expression, Carnegie Mellon University, Pittsburgh, 2009.
5. A. Skriver Hansen, et al., "Pendaphonics: A Tangible Pendulum-based Sonic Interaction Experience," *Proceedings of the 3rd International Conference on Tangible and Embedded Interaction* (New York: ACM, 2009) 153–160.
6. A. Freed, et al., "Musical Applications and Design Techniques for the Gametrak Tethered Spatial Position Controller," *Proceedings of the 6th Sound and Music Computing Conference*, Porto, Portugal, 23-25 (2009).
7. Gametrak, en.wikipedia.org/wiki/Gametrak, accessed January 7, 2012.
8. Cycling 74, cycling74.com, accessed January 7, 2012.
9. OpenFrameworks, www.openframeworks.cc/, accessed January 7, 2012.
10. E. Streb, *Streb: How to Become an Extreme Action Hero* (New York: The Feminist Press at CUNY, 2010) 83.
11. CUNYMedia, "Streb: How to Become an Extreme Action Hero," 2010, www.youtube.com/watch?v=pOAHYF-WtBM, accessed March 21, 2012.
12. R.E. Kaufman, "A Family of New Ergonomic Harness Mechanisms for Full-Body Natural Constrained Motions in Virtual Environments," *3D User Interfaces*, 2007, 10–11 (2007).
13. F. Yang & Y. Pai, "Automatic Recognition of Falls in Gait-slip Training: Harness Load Cell Based Criteria," *Journal of Biomechanics* Vol. 44, No. 12, 2243–2249 (2011).
14. C. Davies & J. Harrison, "*Osmose*: Towards Broadening the Aesthetics of Virtual Reality," *ACM SIGGRAPH Computer Graphics* Vol. 30, No. 4, 25–28 (1996).
15. Motion tracking, 3D scanning, and eye tracking solutions from Polhemus, www.polhemus.com, accessed March 15, 2012.
16. Motivational Environments, STREB BRAVE, video-recorded conversation between Elizabeth Streb and Winslow Burleson, 2009, vimeo.com/17161251, accessed March 21, 2012.
17. E. Streb, excerpt from Dancers Defy Gravity, KJZZ 91.5 FM, November 7, 2009.
18. Wii, www.nintendo.com/wii, accessed January 10, 2012.

# From Wunderkammern to Kinect – The Creation of *Shadow Worlds*

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**ABSTRACT**

**This paper focuses on two projects, *Still Life No. 1* and *Shadow Worlds | Writers' Rooms [Brontë Parsonage]*, to reveal the creative approaches the authors take to site, technology, and the self in their production of shadow worlds as sites of wonder. Informed by the uncanny (re-animation and the double) and an interest in the limen (thresholds in the real and virtual realms), the projects explore white light and infrared digital 3D scanning technologies as tools for capture and transformation. The authors will discuss how they suture the past with the present and ways that light slips secretly between us, revealing other realms.**

## Introduction

This paper will focus on two recent projects: *Still Life No. 1*, installed for Dark Matters: Shadow Technology Art, The Whitworth, Manchester, UK (2011-12), and *Shadow Worlds | Writer's Rooms [Brontë Parsonage]* (2011-12). Our description of these two projects will reveal the different creative approaches we take to site, technology, and the self, in our engagement with and production of shadow worlds as sites of wonder.

For 10 years, a major focus for our collaborative practice has been to examine the nature of the double – what it means to create one, how one might engage with an alter ego, how a double can "stand-in" for oneself, and how to populate chosen spaces with them. It is important for us to make these playful explorations manifest through our work, which often has improvised performance at its heart.

Our artistic practice is informed by ideas of the uncanny (re-animation and the double) and an interest in the limen (thresholds in the real and virtual realms). We return to these themes again and again in our collaborative practice. Our work reveals our long-term fascination with heterotopic spaces – the airport, the museum, publicly inaccessible spaces, as well as culturally loaded spaces [1]. For these reasons we find ourselves, or our doubles, in no-man's land, in imagined realms or occupying well-known collections. The projects described in this paper incorporate our interest in exploring digital technology as a tool for capture and transformation and as a hand-made, improvised, creative response to a situation or space.

**Figure 1. *Moments of Death and Revival* (installation detail), 2008. 3D printed objects (14 figures, 19cm to 25cm high) in acrylic polymer, train, track, lights, plinth, switch. Dimensions variable. Commissioned for Skyscraping at Yorkshire Sculpture Park, 2008, and shown as part of Concrete and Glass, Hoxton Square, London, 2010. © 2008 Brass Art. Photo © 2008 Jonty Wilde.**

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For the past four years we have been researching and developing a body of work that uses digital scanning to capture ourselves as faithfully as possible – exploring the ontological question of what it is "to be." In *Moments of Death and Revival*, our first project to use this technology, a moving light source illuminated a procession of human and hybrid animal models, casting their shadows upon the gallery wall. To create our shrunken doppelgängers, we were scanned using 3D body-scanning white-light technology (Figure 1). As part of this process, we actively tested and pushed the physical dimensions of the 3D body-scanning booth using improvised poses, explored 4D facial scanning to create faithful impressions of our features in motion (in order to develop large-scale 3D inflatable objects), and combined custom-written software with Microsoft's Kinect to capture a "mise en abyme" revealing our disguised selves being recorded. Through these processes, we created doubles and doppelgängers from live data and selected museological specimens.

***Still Life No. 1*, Dark Matters: Shadow Technology Art**

***Perceptual Wonder - The Collection Revisited***

> The awe evoked by global multiplexing, online streaming and desktop computer animations recalls the wonder once aroused by obsolete gadgets and registered in mostly forgotten modes of perception. These magical artefacts similarly operated somewhere between game and experiment, toy and tech. Locating emergent private and mass media in the long tradition of optical aids exposes the multiple ways in which humans have been, and continue to be, playfully entangled with their beautiful devices [2].

Our interest in technological developments in the 18th and 19th centuries – which led to the phantasmagoria show, the panorama and hot air balloon flight – has been a significant aspect of our practice, traceable to the beginning of our collaboration. This interest is made manifest in shadow plays using a motorized light source and in creation of virtual shadows and digital sprites.

**Figure 2. *Still Life No. 1* (installation mid-shot), 2011. Polypropylene, 3D printed objects in resin, from 7cm to 75cm high. Dimensions variable, tabletop 2m diameter. Uncanny "digital doubles," coupling the artists' bodies with mineralogy specimens, create the transparent tabletop landscape. A motorized revolving light suggests a shifting and allegorical relationship to cosmology as it re-animates the landscape and objects through shadow play. © 2011 Brass Art. Photo © 2011 Brass Art and Michael Pollard.**

From 2009–2011, we explored and responded to Manchester University Museum collections for a shadow installation commissioned by the Whitworth Art Gallery [3] (Figure 2). In our previous work with museum stores, we produced photographic works that appear to re-animate taxidermy specimens and illuminate strange juxtapositions of objects. It is significant that we were once again drawn to seek out specimens that had once lived and breathed and were now held in suspended animation, eschewing crafted artifacts and the ethnographic collections in favour of the zoology, mineralogy, and palaeontology collections.

The phenomenology of wonder – "the experience of astonishment before the world and the beginning of philosophy" [4] – is worthy of exploration as an aspect of our encounter with the

museum, as well as the audience's experience of the final installation of re-animated objects. Our sense of wonder comes from the overwhelming quantity of specimens, the surprising juxtapositions and revelations at the turn of a handle or the opening of a drawer. As non-scientists, we approach the museum collection with the same wonder as the collectors of the first Wunderkammern. These cabinets of curiosity were legitimate precursors of the public museum:

> ...the fabulous Wunderkammern, or wonder chambers, of the Renaissance, those immense collections of "rare" objects, where the natural and the artificial – products of "divine" and human craft, respectively – lived side-by-side as objects of amazement [5].

Our approach to the museum collection was eclectic, enabling the formation of our own taxonomies and collections of curiosities for our own ends. We enjoyed the strange illogical relationships that occur between objects not on public display. We were drawn to objects rejected as useful scientific specimens for lack of provenance, the anthropomorphic, the outsized or miniaturized models, the overlooked and outmoded. Our role was as both explorers – responding to unexpected finds and physical phenomena, remaining open to shifts in the outcomes – and directors of a growing number of individuals and companies who worked with us to realize the project.

**Figure 3.** ***Still Life No. 1*** **(installation view), 2011. Polypropylene, 3D printed objects in resin, heights from 7cm to 75cm. Dimensions variable, tabletop 2m diameter. This installation view reveals the scale of the 360-degree shadow play. © 2011 Brass Art. Photo © 2011 Brass Art and Michael Pollard.**

### The Object Twice Removed

Our ongoing work with 3D laser body scanning was extended to include the museum artifacts [6], and we selected a number of objects from the museum collection to be scanned [7]. Using the 3D scanner enabled us to watch a 3D digital copy of each object as it emerged on the screen, piece by piece. Twice displaced and now replicated, this process of removal and digitization marked the beginning of the objects' transformation. The data were stitched, filled, and remotely printed using stereo laser-sintering processes in a transparent resin [8]. The transformation in scale between the original object and its copy is echoed in our own shrunken doppelgängers. These objects are combined on the tabletop still-life landscape and through their re-animation in the revolving shadow play cast onto the wall [9] (Figure 3).

### *Still Life No. 1* – A Shadow Play

The evolution of *Still Life No. 1* has been a playful and experimental process; each test leading to the introduction of new materials, bringing more delicate, temporary, and translucent elements to create both shadows and unexpected plays of light. There is a sense of the Kantian Sublime in relation to the gigantic scale of shadow achieved in the installation space. Our small 3D printed figures are absorbed into a landscape that turns as the motorized light makes its orbit, suggesting a shifting and allegorical relationship to cosmology. In direct reference to the heavens and our historical relationship to its signs, two comets appear. One is harnessed as a kite. The other "haired star" plummets toward a tiny figure holding a net. In other uncanny doublings, our figures appear to hold up elements of the landscape both inside and outside the transparent forms (Figure 4).

In *Still Life No. 1*, the most solid element is not the tabletop collection of imperceptible transparent objects and figures, but the shadow play which animates and completes it. There is a preserved wonder inspired by the museum and the continuous transformations and shifting relationships made possible by the agency of the light. Ordinary cellulose wrapping is transformed into shadows that belie their flimsy origins and in turn create a poetic light play. This is the second aspect of wonder in the work. Stephen Greenblatt, writing in the bulletin of the American Academy of Arts and Science, describes "resonance" in relation to the museum object as:

> the power of the displayed object to reach out beyond its formal boundaries to a larger world, to evoke in the viewer the complex, dynamic cultural forces from which it has emerged and for which it may be taken by the viewer to stand. And "Wonder" as the power of an object to stop the viewer in his or her tracks, to convey an arresting sense of uniqueness, to evoke an exalted attention.

He describes an experience of "wonderful resonance and resonant wonder" in an exhibition worth visiting [10]. In *Still Life No. 1*, the audience becomes entangled in the shadow world as the orbiting light slips past.

***Shadow Worlds | Writers' Rooms [Brontë Parsonage]* (2011-12)**

Three artists have gathered at night in the Brontë Parsonage, Haworth, England [11]. Inside the shuttered dining room, they wait, with disguises in hand, to begin an improvised performance. A photographer leans into the scene and attempts to capture the shadow narrative cast upon the papered wall. An intimate connection among "performers," site, and photographer is established.

Outside the scene, a curator and a collections manager watch from a distance. Between them and the wall, a fifth member of the assembled crowd hovers, approaches the scene, darts forward, and then steps back, Kinect and laptop balanced precariously in hand, like a director overseeing a film – the moment is captured.

**Figure 4. *Still Life No. 1* (installation detail), 2011. Polypropylene, 3D printed objects in resin, heights from 7cm to 75cm. Dimensions variable, tabletop 2m diameter. In other uncanny doublings, the artists' figures appear to hold up sculpted copies of the delicate landscape, standing both inside and outside the transparent forms. © 2011 Brass Art. Photo © 2011 Brass Art and Michael Pollard.**

This was our first performative foray inside the Brontë Parsonage, and it marked the beginning of a new series of works exploring the shadow. It is the second focus for our examination of shadow worlds.

**The Spectral Nature of Technology**

This site-specific project uses two forms of light to capture shadows: a medium-format digital camera to capture frozen moments from each scene as "shadows" on the wall, and Microsoft's Kinect, an on-range camera technology, coupled with custom-built software, to capture the live data from the improvised performance. It was an artistic decision to move our shadows into a new

color-tinted realm that drew us to the wallpaper in the Brontë Parsonage (Figure 5). We wanted to foreground this shift in our practice and draw parallels between our imaginary realm and those evoked by other female artists (writers Charlotte Perkins Gillman; Charlotte, Emily, and Anne Brontë; artist Francesca Woodman, et al.).

**Figure 5.** ***Shadow Worlds | Writers' Rooms [Brontë Parsonage] No. 6*****, 2011. Digital print on Hahnemühle Photo Rag, 70cm x 1m. The artists, working with hand-made masks and props, improvised roles to create shadow tableaux to be photographed. The resulting images allude to "a scene unseen" outside the frame of the final image. © 2011 Brass Art. Photo © 2011 Brass Art and Simon Pantling.**

We chose to work with the Kinect because it was designed for domestic spaces and would capture the "mise en abyme" – the scene within the scene – successfully in the darkened room [12]. The captured shadows in the Kinect footage are, in fact, the points where there is no data, an invisible shadow realm that the human eye cannot trace. The potential of the Kinect and its lasers to reveal and trace this shadowy territory is mysterious: people and objects unexpectedly appear and disappear, sometimes passing through a surface that would appear solid. This invisible realm, with its surprising spatial transformations, intrigues us. It offers us the potential to develop a new form of shadow play as yet uncharted (Figure 6).

On our first nighttime visit to the parsonage, the focus was on using the Kinect to capture our close working relationship with the photographer. We wanted to show the process of our playful action research by recording it as a digitized shadow play. The work in situ is a form of private performance. It is not scripted but is pre-planned to a degree, and it requires spontaneity coupled with our willingness to adopt different personas, characters, props, and roles at will. Our aim is to arrange ourselves into tableaux that can be frozen at a moment in time. The recording of this moment ordinarily becomes the artwork. However, by capturing each of these short durational performances using the Kinect, we are able to review all the possibilities inherent in this new technology and foresee how we might further extend our practice.

The Kinect data can be re-viewed in a number of dynamic ways because the Kinect records the geometry of the space, and everything that takes place within that space, using depth algorithms. We are able to view our actions in real time, fully rotated around any 360-degree point, zoomed, angled, looped, or inverted. The timeline opens up a wealth of editorial possibilities. It was this realization that allowed a conceptual shift in the project, enabling us to put the Kinect center stage on our second nighttime visit, and allowing the digital still camera to capture moments that emerged from our action research. Once again it was possible to capture the scene within the scene, this time with the still camera offering the expanded view of the tableaux.

Having scrutinized the original footage, we further tested some of the scanning parameters, including the effect of reflective surfaces, foil, and mirrors. As artists, we were keen to see if we could disrupt the capture process and influence the likelihood of objects and people appearing and disappearing. As an example, we discovered that the Kinect could not easily

"see" aluminum foil, so we used this material to mask and remove a head in one of the performances. Similarly, mirrors proved to be magical. As in real life, they presented us with a new way to "see" the scene. They enabled us to re-present the view of the room back to the Kinect and allowed parts of the performers to vanish as the frame and reflection occluded our forms.

Throughout this iterative process, there remained a key focus: how could we manipulate the data holes and thus extend the reach of the shadow forms? Our discovery, achieved through playful improvisation with the equipment, was that the larger the distance between the objects, the walls, and the Kinect, so too the greater and more immersive became the shadow forms on screen. By placing ourselves at specific distances from the Kinect, we could manipulate the scale and reach of our shadows, and achieve a new, digital shadow world.

The still images provide interesting documentation, particularly when the camera "records" reflected or deflected action in a mirror and captures unexpected forms cast onto the scenes and figures. Concurrently, the data captured by the Kinect in the second visit is more considered. With a refined understanding of the playback possibilities for the Kinect footage, we were able to fully utilize the rotating view for an improvised dance scene around the dining table – the table the sisters walked around whilst reading aloud to each other from their works. Other scenes necessitated a fixed view to enable the illusion of disappearance, which a rotating view of the room would have undermined. In a site laden with historical resonance, our actions have both connected with the past and recorded a new layer.

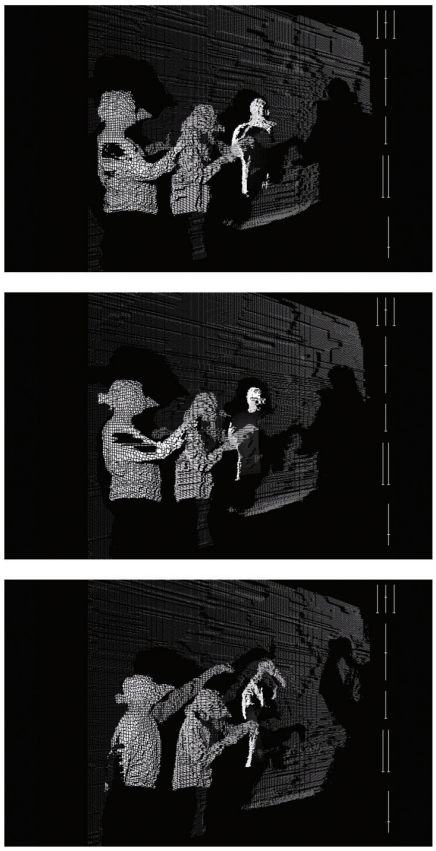

**Figure 6.** ***Shadow Worlds | Writers' Rooms [Brontë Parsonage]*** **Dining Room (video capture from Kinect scanner), 2011. Projection dimensions variable. Using infrared light to capture short sequential narratives offered new possibilities for creating a shadow play using depth algorithms, distance, and a variety of materials and props – some visible and others invisible. This playful approach expanded narrative possibilities through a series of carefully crafted illusions. © 2011 Brass Art. Photo © 2011 Brass Art and Spencer Roberts.**

### The Shadow Realm

Throughout history, there have been interesting and divergent ideas about the shadow (Plato, Descartes, Stoichita, et al.) and differing views of what a shadow reveals. A shadow can mark a determined reality: "It is through a shadow that a being is determined, where his identity is defined" [13]. It can also open up a mysterious space: "There are many more enigmas in the shadow of a man who walks in the sun, than in all religions of the past, present and future"[14].

The shadow realm suggests both substance and outline. It can reveal the world for what it is, and it can surprise us with an unexpected glimpse of a positive world turned negative. This shifting dichotomy is what makes this territory such a rich and fascinating world for us to inhabit as artists. We are drawn to the shadow as a recurrent motif in our collaborative practice because of its ability to act as a source of wonder. It enables us to oscillate between these shifting and polarized viewpoints:

> For is the soul, in turn, nothing but yet another representation – a butterfly, a shadow? [15]

### The Wonder of Vision

In capturing the "mise en abyme," we wanted to reveal the whole scene, the entire improvised performance, including the photographer [16], the Kinect director [17], the museum curator, and surrounding artifacts using two distinct time-based technologies. As Decartes wrote: "What do I see . . . but hats and cloaks, which can cover ghosts or dummies who move only by means of springs?" [18]. What is interesting and disorienting about the process is that the shadows cast by our figures (both disguised and simply "being") and seen by the lasers are entirely unseen by us during the process. They are also different to those captured by the lens of the medium-format camera. The two approaches we have used offer different perceptions of the space. The photographs allude to "a scene unseen" outside the frame (Figure 7). The video reveals that scene but simultaneously records "an unseen shadow realm." The juxtaposition of the works might lead the viewer to question their perception of the space, just as Descartes questioned his perception of an ordinary view.

**Figure 7.** ***Shadow Worlds | Writers' Rooms [Brontë Parsonage] No. 3*****, 2011. Digital print on Hahnemühle Photo Rag, 70cm x 1m. This photograph was captured in the alcove of Mr. Brontë's Study. It reveals an intimate yet ambiguous relationship and demonstrates how the interior architecture of the site distorted and contained the cast-shadow realm. © 2011 Brass Art. Photo © 2011 Brass Art and Simon Pantling.**

### A Shadow Play for the Brontës

When we show the clips of us working within the Brontë Parsonage, we are aware of a rapt attention within the audience. Whether this is the result of a perceived hauntology within the space or whether it is the surprising ability of new technologies to simply reveal what we cannot see, it is fascinating to us. It was this willing suspension of disbelief that first drew us to pre-cinematic spectacle as an important area for research within our own practice.

In approaching this new project, *Shadow Worlds | Writers' Rooms*, and in particular the Brontës' world, we were drawn to the Glass Town Country of the Brontës' childhood. This deliberately playful world is one that intrigued us. Play is at the heart of our own collaborative practice – a way of exploring possible futures and alternative pasts. Literature is an important source of inspiration for us, and our engagement with the parsonage as a site where narratives were imagined, acted-out, written, and inscribed in time presented not only a resonant site, but also a site where shadows could be "revealed" and re-written.

It is important to make clear that we had no desire to re-tell the life story of the Brontës, nor the plot of any of their novels. Rather, we wanted to inhabit their creative space and allow it to influence us in unexpected ways. The constraints and possibilities afforded by the interior architecture distorted and contained the shadows. We were aware of inhibitions of physical action coupled with an unbounded imagination. New dynamics between characters and sequential narratives emerged alongside our shape shifting and digital disappearances. In this sense, the space itself acted as a shadow, casting an echo of its past into our present. In turn, we created something in the present sutured together with the past. This is the final point to make: The uncanny pervades time, slipping forwards and backwards, unraveling the past and creating the future. Light slips secretly between us and those who came before us. Like an agent of wonder, it reveals a mysterious realm.

**Acknowledgements**

Brass Art would like to thank Helen Stalker, curator, The Whitworth Art Gallery, UK, and Jenna Holmes, curator, Brontë Parsonage Museum. All images courtesy of the artist (Brass Art) and The International 3 Gallery, UK.

**References and Notes**

1. Brass Art, www.brassart.org.uk.
2. B.M. Stafford, *Devices of Wonder* (Los Angeles: Getty Research Institute, 2001) 2.
3. The Whitworth Gallery (www.whitworth.manchester.ac.uk/) and Manchester Museum (www.museum.manchester.ac.uk/) are both part of Manchester University. The commission by The Whitworth for the international group exhibition Dark Matters: Shadow Technology Art (www.whitworth.manchester.ac.uk/whatson/exhibition/ darkmatters) gave Brass Art a unique opportunity to gain access to the museum stores and the expertise of individual curators. *Still Life No. 1* was supported by the Association of Art Historians, the University of Huddersfield, Ogle Models and Prototypes Ltd, and Huntsmen. darkmattersart.com
4. M. Kingwell, "Husserl's Sense of Wonder," *The Philosophical Forum* Vol. 31, Issue 1, 85 (2000).
5. C. Olalquiaga, "Object Lesson / Transitional Object," *Cabinet* Issue 20, Ruins (2005/06).
6. Digital Doubles, www.digitaldoubles.org.
7. Scanning at Manchester Metropolitan University, School of Engineering, United Kingdom. 3D body scanning supported by Wicks and Wilson Ltd., United Kingdom.
8. 3D data were repaired at Liverpool National Museum's Conservation Technologies Department and printed at Ogle Models Ltd., United Kingdom, with sponsorship from Huntsmen.
9. The circular table for *Still Life No. 1* with motorized revolving light was designed by theater engineer Andy Plant. This enabled Brass Art to move away from the garden model railway sets, which had facilitated linear light locomotion in previous installations (*Moments of Death* and *Revival*) and return the audience's focus to the shadow play.
10. S. Greenblatt, "Resonance and Wonder," *Bulletin of the American Academy of Arts and Sciences* Vol. 43, No. 4, 11–34 (January 1990).
11. The Brontë Parsonage was the family home from 1820 to 1861. Charlotte's novel *Jane Eyre* (1847), Emily's *Wuthering Heights* (1847), and Anne's *The Tenant of Wildfell Hall* (1848) were written in this house. The Brontës, who published under the pseudonyms of Currer, Ellis, and Acton Bell, were acknowledged at the time for their directness and powerful emotional energy, qualities which were sometimes interpreted by the critics as "coarse" and "brutal." www.bronte.info/
12. In 2009, we researched the potential of using Lidar scanning for a commission at the Lyric Theatre, Hammersmith, London, to capture both the outside of the building during its architectural transformation and performances that took place within its interior. Our aim had been to composite these viewpoints and to focus on the negative spaces within the process – in other words, focus on what was most often unseen. A colleague, Spencer Roberts, working with the Kinect, was interested in how we envisaged using the technology to explore the shadows created in the captured data, and a collaboration was formed.
13. V.I. Stoichita, *A Short History of the Shadow* (London: Reaktion Books, 1997) 171.
14. V.I. Stoichita, *A Short History of the Shadow* (London: Reaktion Books, 1997) 145.
15. V.I. Stoichita, *A Short History of the Shadow* (London: Reaktion Books, 1997) 185.
16. Simon Pantling, www.pantlingstudio.com/.
17. Spencer Roberts, author of custom-built software for Kinect, spencerroberts.artsident.org/.
18. R. Descartes, *Discourse on Method and the Meditations* (Harmondsworth, United Kingdom: Penguin Classics, 1968) 110.

# Entr'acte

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**ABSTRACT**

**Looking at new public-space formations today, the roles of new technologies grow not only prominent but also noticeably time-sensitive. Due in part to the rapidly changing nature of communications media and the diverse stakeholders, the theatrical "entr'acte" appears to be an apt model for forms and durations of public space with diverse performers (both human and material elements) of different sorts: entr'acteurs. How is public space as physical construct changing with new embedded forms of computing? How is a public formed? What new material sensibilities emerge? And what role does their essentially fleeting or transitional character play?**

The proliferation of embedded technologies over the past 20 years – the gradual migration of human-computer interaction from desktop to things, place-based, wearable and otherwise, situated often invisibly but strategically in the routine situations of daily life – has starkly affected both the conception and use of public space. Thanks to the evolving forms and practices of urban computing [1] – ranging from instant messaging to successful organizing and demonstrating in city squares against dictators to everyday navigation for a coffee date – place-based, wearable, and mobile electronics represent a current iteration of the phenomenon identified in 1991 by Mark Weiser as "ubiquitous computing" [2], and it most recognizably affects uses of open public spaces, from streets and plazas to the very air above.

After all this time, we can now also begin to recognize some relationships between material and scalar orders in the behavior of very large organizations (VLOs). VLOs are a phenomenon of our day and subject to further elaboration elsewhere, as the built environments of public assembly, work, agriculture, incarceration, trade, travel, education, even death join global financial and communication networks. The planning and infrastructure for these systems demand logistics, capital, and services for a new order of population magnitude that must accommodate volatile shifts in spatial and computational stability. Adaptability is at the crux of dealing with diverse users or publics and unprecedented technical, cultural, social, and ecological challenges. Thanks to urban computing, Garrett Hardin's notion of the *commons* [3] – understood here as both public space and discourse – today calls for new modes of work to harness its potentials for architecture, and new models to name it. One such model is the *entr'acte*.

The *entr'acte*, a term from theater also translated as *Zwischenspiel* and as *intermezzo*, denotes the time and space between parts of a stage performance. Generally taking place before closed curtains as settings are changed, the entr'acte delivers a fleeting new purpose and event to the otherwise sometimes inert space between stage and pit. While the history of this term (the French being not only the earliest, but appropriately close to our current use of the word "interact") reaches back at least to 1760 [4], its use in print clearly spiked twice in 1924, with the release of French Dadaist René Clair's film *Entr'acte*, performed with the premiere of Erik Satie's *Furniture Music* and shown in Paris as part of Jean Börlin and Francis Picabia's ballet *Relâche*. This was the first known intervention of cinema in a live dance performance and

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hence perhaps the first intermedial construction of space-time in performance. The music and film were intended to fall into the background unnoticed and mimic the chatter that audiences would ordinarily produce during an intermission, much as ubiquitous computing tends to do today. As legend has it, audiences ironically sat quietly listening, thus frustrating the performers. And so the theatrical entr'acte presents its mixture of mediated and physical space, its effort to create cultural and social relations within a space-time of distraction; its ephemeral protocols of spectator-actor disruptions are characteristics of the urban entr'acte's appearance in mediated public space today.

In today's public-space formations, roles of new technologies are both prominent and noticeably time-sensitive. Communication media and practices of urban space use and uses of technology change rapidly, yet physical construction of urban spaces changes slowly and with investments of capital from discreet sources (developers, governments) rather than the distributed, sometimes user-driven development of media networks that so abruptly change the lives of urban spaces. The entr'acte is an apt model for analyzing and synthesizing – *creating* – new forms and durations of public space. The entr'acte as model public space is one that can defy traditional limits of design and construction, allowing us to build publics without vast material intervention and deployment of capital to consider differences between "publics" and "commons," to revisit old notions of "planned obsolescence," and to recognize a diverse new set of players – both human and material elements – as *entr'acteurs*.

**Figure 1. Still from the 1980 film *The Social Life of Small Urban Spaces*, by William H. Whyte, showing time-lapse camera and daylight washing across Seagram Plaza. © 1980 Municipal Art Society.**

This paper examines a set of cases in different fields in order to identify different forms of entr'acte that emerge today, and to speculate on how they can reframe the spatial, temporal, and social terms of the commons now. It also self-consciously attempts to learn from the inherently interdisciplinary origin of the theatrical entr'acte, as something that was always medial, architectural, social, and performative. In this sense, the use of this term is intended to promote an ongoing invention where fields and discourses meet.

### Analysis

The entr'acte has already been identified through numerous important analyses of publics and public space, all found between the disciplinary boundaries of media theory, urban studies,

crowd psychology, architecture, and performance theory. A family of such analyses can be found in works by by Elias Canetti [5], Howard Rheingold [6], and William H. Whyte [7]. In the books *Crowds and Power* and *Smart Mobs*, and in the film *The Social Life of Small Urban Spaces*, respectively, these authors test diverse positions on public-space formations viewed from the outside, observing the movements and props, shapes, and boundaries of crowds themselves. In Canetti's book, each section identifies and then analyzes a different type of crowd or pack by its boundary condition, its process of formation, its mentality, or other circumstantial catalysts. Topics like The Fear of Being Touched, Slowness, Kinds of Pack, and Epidemics typify a study that tries to understand often inherently violently relating publics through history. Canetti formulates a taxonomy of crowd types and psychological affects, correlating these to timeless protocols of public interaction. Public space and public behavior are always fleeting and intertwined for Canetti, yet their forms persist and reappear over time. Rheingold's 2003 work, on the other hand, is to be read in its moment and projecting forward, both declaring and calling for development of collective intelligence and new social practices in the use of mobile technologies in urban space. *Smart Mobs* is a celebratory work that finds nothing less than social revolution in distributed power provided by mobile telecommunications and anyone who is able to be an effective activist thanks to "technologies of cooperation" and swarm intelligence. Rheingold continues to advocate for wirelessly communicating publics as an emergent political-social-technological-urban form – an inherently contemporary entr'acte, in short – through the book's continuing web site and his blogging, tweeting, and public speaking. Whyte, by contrast, takes a fairly laconic stance in his use of film. Produced in 1980 for New York City's Municipal Art Society, Whyte's film trains its camera on Mies van der Rohe's Seagram Building (Figure 1) but pointedly chooses to say nothing of it *per se*. Rather, the building plaza and other nearby places like Paley Park appear as a proscenium for unscripted (or, perhaps, subconsciously scripted) actors, each with their own props: movable chairs, water, even sunlight itself. This could be seen as proto-technological in its relation to Canetti and Rheingold, as public space literally frays at the edges, and its activities are observed live, albeit from a distance, to be growing and improvisational by design and within controlled parameters tacitly determined by the administrations of these urban spaces. In other words, one might see all three authors as identifying and analyzing fleeting public-space formations, yet each associates particular temporal, technological, and spatial characteristics to their subject. For Canetti, power and hegemony determine *ur*-entr'acte formations. For Rheingold, mobile communications unleash unpredictable, anti-hierarchical, productive formations that transcend physical boundaries in

**Figure 2. Video still from youtube, Michael Jackson Flash Mob, Embarcadero Plaza San Francisco, 2009. © 2008 The Hero.**

public space (Figure 2). For Whyte, everyday public interactions are literally viewed as performances, loosely staged by elemental physical mediators like warmth, sound, and rest. These all analyze crowds as actors, individuals with collective behaviors, and temporal and spatial patterns subject to manipulation, optimization, suppression, and perhaps emancipation. Control comes to the fore in this mode, a measure of rupture in the life of public spaces relative to their programmed uses and regulation of things like movable chairs, fountains, network outages, and place-based sensors.

**Figure 3. Boal workshop at Riverside Church in New York City, 13 May 2008. © 2009 equalityisforall.**

By contrast, Brazilian theater director Augusto Boal [8] literally analyzes or dismantles actor-public relations with the "spectactor." This creation, both literally theatrical and generative of a public, was conceived against the backdrops of complementary positions found in Brecht's Epic theater and Artaud's Theater of Cruelty [9]. Briefly, the three theatrical models seek audience engagement as publics by way of framing the experience of *immersion*, a byword familiar to media-interaction design today. Artaud sought literally to surround and envelop audiences viscerally, physically, and ultimately psychologically with stage and production, setting publics into sudden unity through their immersion in the spectacle. Brecht departed from this with his total distaste for illusion, constructing stagings that fostered an audience's intellectual awareness of the production, purging all illusion or emotional manipulation. This strategy separated social and spatial constructions in order to draw distinctions between the theater event (as a space of discourse) and public space outside (as real spaces of negotiation, where lessons learned in the theater could be implemented). Today, Boal sets out to eliminate the difference between performer and public altogether by developing a workshop method of collaborative *spectactorship*. Here, strategies involving workshop scenarios, erasure of proscenium seating, and the attendant inundation of all present with the event of performance contribute to the systematic disturbance of distinctions between the audience and actors, resulting in a mass of *spectactors* (Figure 3). The spectactors' double lives as full participants are essential to fostering collaboration that is resistant to any fixed power structure or spatial configuration. This process actively seeks to transform its audience as actor, to construct a scenario with like participants from the start, and to plan ahead strategically rather than tactically. It stages interventions proactively, with precise arenas of interest and known starting points.


**Figure 4. Production photo: The Builders Association, *Super Vision*, 2005. © 2005 The Builders Association. Photo by dbox.**

### Synthesis

What, then, does the entr'acte look like *in the city itself*, what situations does it model, and how is that model deployed? Beyond the immersion of media environments and their spectacular results in urban screens, the entr'acte's greatest potential exists in the social and material amalgams that rapidly organize and reconfigure the commons. These constructs can be recognized by their different *methods of synthesis*, which are determined in turn by limited temporal and spatial circumstances. The following examples illustrate four of these synthetic methods of creating the entr'acte, as Sampling, Retinal, Social, and Embodied. These are recognizable methods of deliberate creation of the entr'acte today, and a starting point for new ones.

#### *Sampling*

In *Continuous City* [10] and *Super Vision* [11], two black-box theater performances conceived and performed by The Builders Association since 2005, onstage performers interact with one another, the seated audience, and a larger-than-life projected screen simultaneously. The many interwoven narratives that occur between the screen and the stage make reference to our habits of sampling ourselves and our databases in real time. Identity theft, border controls, business development all crisscross unstable regions of mediated space and time. Though these parafictional narratives take place in the theater, they are also networked in real time to family members of the cast (Figure 4). Through subtle variations in each iterative performance of the show, an evolving narrative structure is generated that combines on-site filming and a participatory web site that contributes new content for each location, resulting in a cinematic-staged hybrid not entirely unlike René Clair's 1924 *Entr'acte* on the Champs-Elysées. The productions are semi-scripted, quasi-contained spectacles with the audience, a sampling also of routines undertaken outside by all present and necessarily evolving by location and over time as each new city provokes presentation of different common ways of interacting with media technologies. At the outset of each performance of *Super Vision*, the audience itself is converted to a protagonist by a welcoming speaker, who riffs on actual demographic information gleaned from anonymized postal code and credit card information used to purchase that night's tickets. As the speaker tells the audience about itself and its consumer, age, and political tendencies, *sampling* of the public's information

– its "databody," as Builders director Marianne Weems refers to it in the show's script – introduces the night's work and its space, straddling the proscenium and the spatial and computational spaces in which audience members live. Sampling is process and object here – the spatial condition in which a public comes together – and these are the terms of *Super Vision* as an entr'acte.

***Retinal***

The *retinal* entr'acte brings live audience engagement with its own data out to the urban sphere by deploying provocations that match-cut scales of experience to one another, from the eye (the space of vision) to the sky itself (perhaps the most elusively public space to define) [12]. Here we can revisit Hardin's notion of the commons and its shifting atmospheric construction. In Hardin's argument, the commons is bound up with its tragedy in human selfishness: shepherds will always have individual incentive to bring another sheep to graze on a commons, but the inability for a common pasture to support limitless sheep leads to its destruction when the pasture is overexploited. This calls for a "fundamental extension of morality" rather than any technical solution, and an abandonment of key freedoms in the commons. In the context of population density, Hardin grimly concludes: "Freedom to breed will bring ruin to all." This global conclusion is literally a result of the global problem that was his subject. For this discussion, we can scale down the commons from the global again. As an urban construct of both public space and public discourse, atmosphere serves as both space (the air, the sky, pollution) and discourse (urban policy, public events). This atmospheric commons opens participants to engage with the questions of morality that Hardin described.

**Figure 5. HeHe, *Nuage Vert*, St. Ouen, France, 2008. © 2009 HeHe.**

*Nuage Vert (Green Cloud)*, conceived and mounted since 2004 by the Paris-based partnership of HeHe (Heiko Hansen and Helen Evans), relies on the courageous collaboration of an enlightened local power utility (hence there has been only one full realization to date, hosted in Helsinki). This cloud looms over the city nominally as a nighttime urban light installation, relying technologically only on thermographic cameras and a high-power laser light. Projected on the plume of exhaust from a power plant chimney, the green laser draws and redraws the cloud's contours perpetually (Figure 5) as an index of the city's household waste incineration. The resultant spectacle might end as a classically detourned urban moment, a monumentalization of an environmental pathogen hiding in collective plain sight. But the project is supported by a city-run media campaign to get residents to produce less waste and collectively make the cloud vanish. This process uses the spectacle as a prop to mediate between the power plant itself, the mayor, non-profits, and citizens, all as *entr'acteurs*.

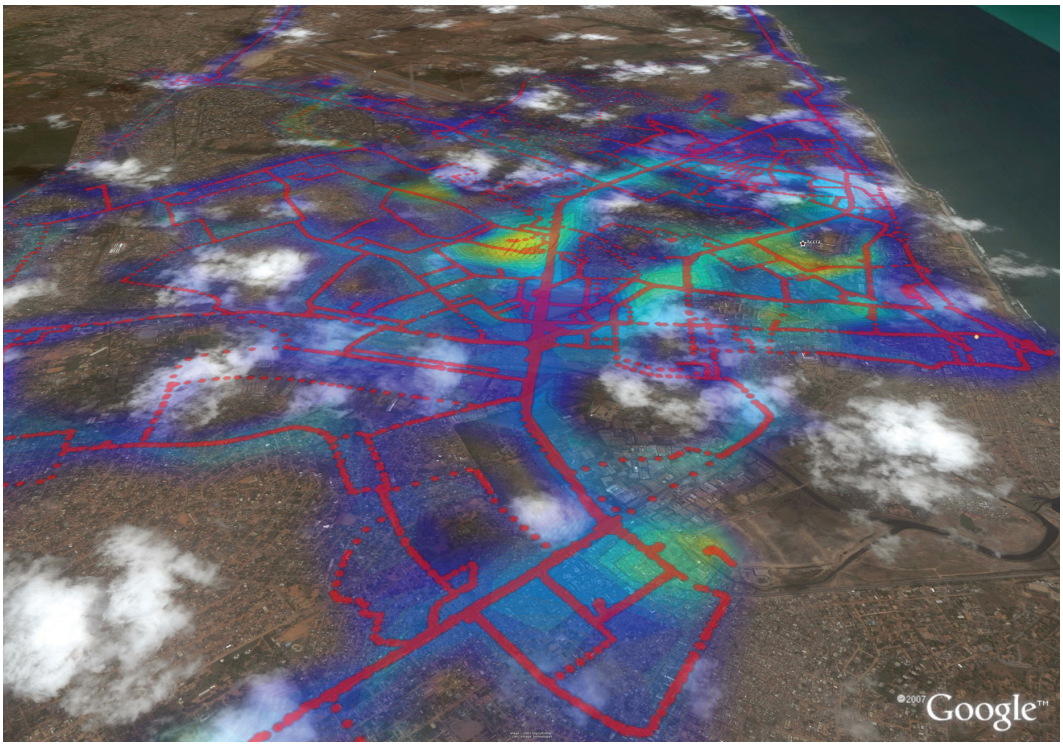


**Figure 6. Eric Paulos, Participatory Urbanism: carbon monoxide readings across Accra, Ghana, 2006. © 2008 Eric Paulos.**

*Nuage Vert*'s particular constellation of media does not include the typical components of urban computing, but many of its protocols engage with remote sensing within the context of a contemporary atmospheric commons, one that fuses *the public as space*, *as participant*, and *as air quality*. As an entr'acte, the project is also fleeting in its month-long administration as an art project, but maybe even more so in its self-destructive formation, since it attempts to reduce waste until the project's own matter itself vanishes.

***Social***

This type of participation gestures toward a form of the social entr'acte, a construct independent of visual spectacle. The social entr'acte might have its progenitor in *social sculpture* as it was coined by Josef Beuys. In his *7000 Eichen (7000 Oaks)* (1982-1987) [13], Beuys dutifully if heroically replanted a barren Kassel at the behest of the Documenta art festival – its visual artifacts not so much spectacular as hiding in plain sight, literally about as interesting to watch as grass grow, and measurable for their progress alongside the one-meter basalt steles placed next to each tree. Anyone could plant one of these trees and contribute to the "healing" that Beuys hoped to bring about for the city. Participation is at the heart of social sculpture, an invitation organized by the artist that constructs a visible commons but by social protocols.

The *social* entr'acte is visible but sometimes only incidentally so. Its deployment of crowds, space, and mediation creates new forms of agency for largely familiar objects. Participatory Urbanism, for example, is a set of objects – mostly cell phone attachments – created by Eric Paulos and his collaborators and generated out of his expertise as an electrical engineer, his practice as an artist, and his personal love of citizen science. Participatory Urbanism consists of various simple custom electronic devices that ride opportunistically on mobile hosts, each with environmental sensors – on taxis in Accra, Ghana (Figure 6), on street sweepers in San Francisco, or attached to cellular phones anywhere. These devices append existing urban technologies, in each case gradually turning pedestrian and automotive participants alike into *expert amateurs*. The expert amateur is a key term for Paulos, as it is born of the practice known as citizen science that

empowers anyone to be a generator of data rather than only a recipient or reader. Here we see *entr'acteurs* come into focus and assume names. Akin to the spectactor in the realms of research, the *citizen scientist* began with the annual Christmas Bird Count inaugurated a century ago by the Audubon Society, for which anyone is invited to collect and help build a collaborative sense of bird migrations. Similarly in Paulos' works, any participant enabled with his team's devices can feel empowered as an expert amateur, contributing to and benefiting from a live feed of data on urban NOx conditions – mono-nitrogen oxides, an indicator of greenhouse gases – by receiving live maps and messages on their phones that help make decisions about their movements in the city. Paulos conducts workshops in which he discusses the many sensors that most cell phones already contain, from light meters to accelerometers, and how urban computing can engage citizens by asking questions about their cities. Paulos' objects resemble and even attach to the technologies situated in public space already, yet they suggest a potential to spark next objects, next spaces, as their own usefulness fades into obsolescence.

### *Embodied*

Finally, the *embodied* entr'acte synthesizes movement and sensation, allowing dynamically shifting relations between individuals and crowds in motion. Motion is an essential freedom in urban space and in urban computing environments created by the embodied entr'acte. Ultimately, freedom of motion may emerge as the most salient – if classical – characteristic of the entr'acte in general. It enables rapidly shifting formations of publics, of public discourses and public spaces. It also fuses the roles of haptic and sensed, material qualities of public space as they have been defined, from sound and warmth (Whyte) to touch and fear (Canetti), with the rapidly evolving forms of urban computing that are changing participation in the commons by mediating air (Paulos) and privacy (Builders Association).

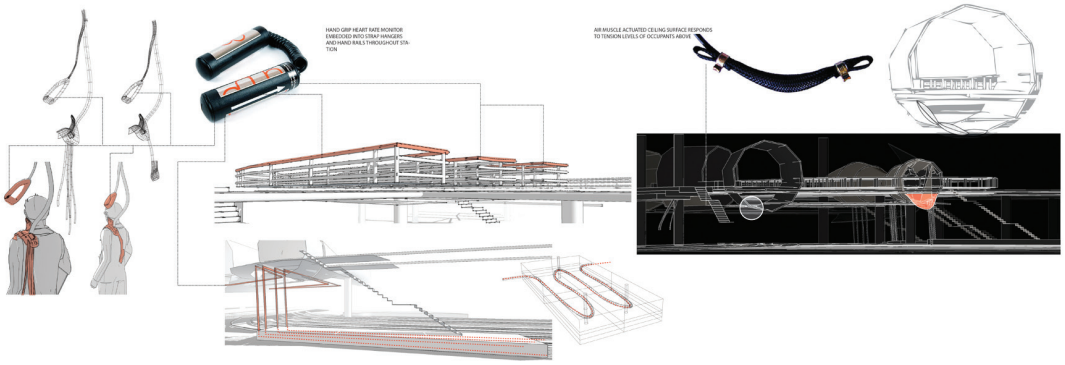

**Figure 7. Michael Kirschner, *Feeling*, systems diagram at trolley turnaround, 2010. © 2010 Buffalo Architecture / Michael Kirschner.**

These are some of the ideas present in Michael Kirschner's *Feeling*, a set of speculative studies for the "moving crowds" that Elias Canetti identified in his book and that can be found in Toronto's citizens in their daily commute [14]. *Feeling* is located in three sites (underground, above water, and above ground) (Figure 7) along a major commuter artery that leads to Nathan Philips Square, the plaza in front of city hall downtown. In each, invented new prototypes augment everyday interactions in public spaces and occupy the place of distraction between strangers, sometimes literally reaching their hearts. The *Feeling* wearable heart monitor (Figure 8), for example, is based on the same technology found in common running gear today for sensing biometrics, but it also taps pressure points on its wearer in response to received pulses from nearby wearers. This interaction is based on proximity and on feeling a common urban object, such as a straphanger on a streetcar. It opens the opportunity for a public formation based on purely felt communication and in which the sort of pack mentalities analyzed in Canetti's

*Crowds and Power* can be made palpable, negotiable individually, and built collectively, and fused with the physical matter of public-space infrastructures of the city. The proposal has an unabashed creepiness to it, since it pushes corporeal, informatic, and urban boundaries to a logical convergence in a way that might already be occurring and that could well turn completely dystopic. But it also hands agency back to the "extension of morality" that Garrett Hardin found necessary in preserving any commons, since pulse itself becomes everyone's concern once they opt in.

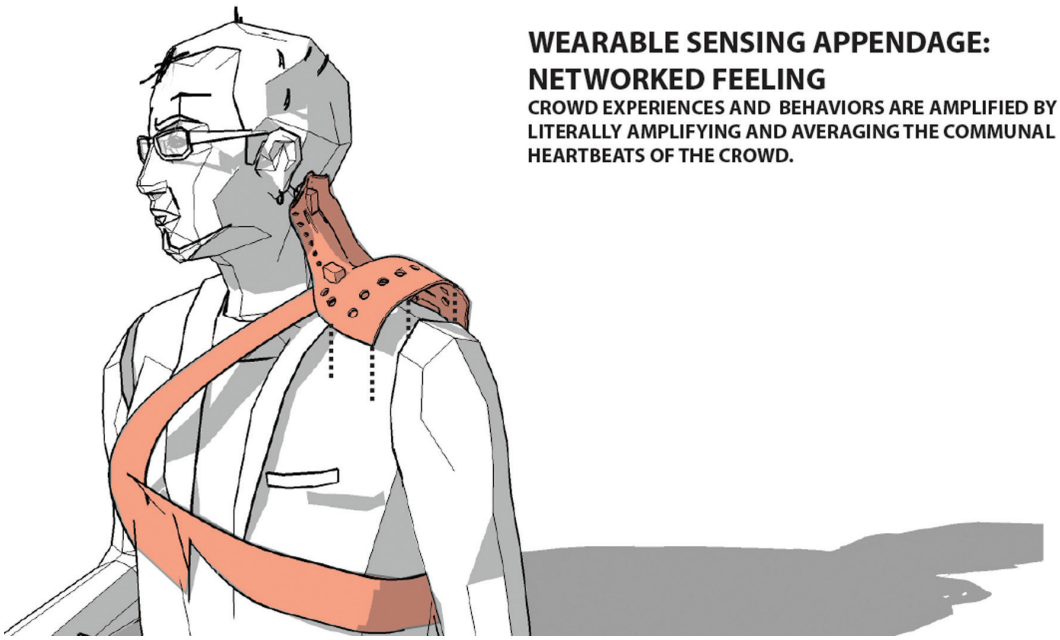


**Figure 8. Michael Kirschner, *Feeling*, heart monitor, 2010. © 2010 Buffalo Architecture / Michael Kirschner.**

### Conclusion

The entr'acte is a fact – not a cause but a model and a method; it has long been with us in our performances and in our formation as publics onstage and in the streets, online, and in motion. Today the stakes and the opportunities for us all as entr'acteurs are different: to live within the fleeting changes in technologies and motion, in physically and digitally mediated spaces, as citizens and scientists, artists, architects, and so on. The entr'acte might ask us to stop thinking of public space altogether and replace it with the *commons* in all its appearances as both space and discourse, material and immaterial. This entr'acte serves us, in short, not only for analyzing and understanding the hybrid and evanescent natures of the commons in transition today; it also charges us with engaging, synthesizing, and, importantly, disciplining how we form it (through the retina, through embodiment, etc.). The entr'acte now requires qualification and cultivation at each instance, so we can all continually learn to best participate as individuals within a world of very large organizations.

**References and Notes**


1. The field of urban computing is already being vigorously studied, and its history and theory are being written as they evolve. Refer for example to the annual UbiComp, Pervasive, and MediaCity conferences around the world and to recent books such as M. Shepard, ed., *Sentient City: Ubiquitous Computing, Architecture, and the Future of Urban Space* (Cambridge: MIT Press, 2011) for more.
2. M. Weiser, "The Computer for the 21st Century," *Scientific American*, Vol. 3, Issue 3, 94–104 (September 1991).
3. G. Hardin, "The Tragedy of the Commons," *Science*, Vol. 162, 1243–1248 (December 1968).
4. A. Bouchard, La Langue Théatrale, Vocabulaire (Paris: Arnaud et Labat, Libraires-Editeurs,1878).
5. E. Canetti, *Masse und Macht* (Hamburg: Claassen Verlag, 1960). www.google.com/url?q=http%3A%2F%2Fopenlibrary.org%2Fsearch%3Fpublisher_facet%3DClaassen&sa=D&sntz=1&usg=AFQjCNFavVRy62zoHaouVOCjSST7c3SPeQ
6. H. Rheingold, *Smart Mobs: The Next Social Revolution* (New York: Basic Books, 2003).
7. W.H. Whyte, *The Social Life of Small Urban Spaces* (New York: Municipal Art Society of New York, 1979).
8. A. Boal, *Theatre of the Oppressed* (New York: Theatre Communications Group, 1993).
9. This dialogue of sorts plays out in text, first proposed in A. Artaud, "Le Théâtre et son Double," *Collection Métamorphoses No. IV* (Paris: Gallimard, 1938), and continued in B. Brecht, 1948–1956: Antigonemodell 1948: Couragemodell 1949. Über die Benutzung von Modellen (Berlin: Aufbau-Verlag, 1964).
10. The show is presented online at www.continuouscity.org.
11. Super Vision, a collaboration with the design firm dbox, is documented online at www.google.com/url?q=http%3A%2F%2Fwww.superv.org&sa=D&sntz=1&usg=AFQjCNFzwr4qSQ8wmJsG-CPSpGrTRHc7xQ.org/.
12. A precursor to this sort of event construct that has received a fair bit of interpretation of late is Ant Farm's 1975 *Media Burn*, in which the group created an elaborate Independence Day faux-reportage at the launch and crash of a souped-up Cadillac into a pyramid of flaming televisions at San Francisco's Cow Palace parking lot.
13. This work and its history are recounted thoughtfully and with quotes from the artist on the web site of the Dia Center for the Arts, at www.diaart.org/sites/page/51/1295.
14. The project was produced in my 2010 graduate level "Entr'acte" studio, taught for the Situated Technologies Research Group at the University at Buffalo.

# Soundspheres: Resonant Chamber

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**ABSTRACT**

**This paper develops a brief historical account of the architectural development of auditory space and identifies the "soundsphere" as an acoustic project that connects the interrelationships between material, spatial form and sound. The instrumental design of the soundsphere has focused on three types of shells: hard, static, and inflexible; physically manipulable; and immaterial (or electroacoustic). This frames a disciplinary and historical context for Resonant Chamber, a prototype-based design research project that develops a kinetic and interactive interior envelope system aimed at transforming the acoustic environment through dynamic spatial, material, and electroacoustic technologies.**

## Introduction

> Auditory space, so critical to architectural problems today, is usually defined as "a field of simultaneous relations without center or periphery." That is, auditory space contains nothing and is contained in nothing.
> - Marshall McLuhan [1]

In his 1958 *Poème Electronique*, the architect Le Corbusier developed, in collaboration with composer Edgard Varèse, a total sensorial experience of light, sound, and image. The carefully curated imagery and colors presented in essence a cosmogony in seven sections. Meanwhile, Varèse's soundscape (although this term had not yet been invented) made use of 350 loudspeakers to create a spatial sonic experience, localizing sounds within the space and moving sounds through the space. Curiously, perhaps, Le Corbusier seems to have prioritized the spatial effects of sound and light production over his efforts on the design of the vessel the Philips Pavilion, which he seems to have left primarily in the hands of the project manager in his office, Iannis Xenakis [2]. Was it that Le Corbusier was more concerned with the fluid and dynamic auditory space (identified a few years later by McLuhan) than with its static container? In the ongoing project of defining the relationship between space and enclosure, center and periphery, material and void, transient and static, the electronic technology of the loudspeaker and artificial lighting had rendered the enclosure, the building, the architecture in a classic sense, superfluous. *Ceci tuera cela.*

**Figure 1. (l-r) Solid shells: Danish Radio Concert House Auditorium, Copenhagen, 2009, Ateliers Jean Nouvel; manipulable shells: Danish Radio Concert House Recording Studio, 2009, Ateliers Jean Nouvel; immaterial shells: 40 Part Motet, Venice, 2010, Janet Cardiff. All photos by the authors.**


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Within the architectural traditions of auditory space, two distinct histories may be found: one of sound control in the physical realm of form and material, and the other in the electroacoustic realm of signal processing technologies. Resonant Chamber is a prototype for a responsive acoustic envelope system that aims to create a transformable acoustic environment that operates within the space of tension between these two realms. The work is developed through computational and material testing, as well as full-scale prototype installation, and it combines kinetic components with computationally driven sensing and actuation regimes that dynamically transform the acoustic environment relative to both sonic inputs and human interaction.

## Background

### *Soundspheres*

Within architecture, the acoustic project, or what might be termed the soundsphere, may be defined as a perceived volume of acoustic control or apprehension, variable according to spatial, material, physiological, psychological, social, and political contexts. The intentional shaping and control of aural space through the interaction of form and matter goes back to the original traditions of Western architectural practice and theory: ancient Greek amphitheaters, such as those at Miletus, Rhodes, Syracusa and Epidaurus, have all been found to deploy specific geometric and construction techniques to control and project the sounds of the performers [3]. Vitruvius famously and influentially describes the use of bronze sounding vessels to tune the acoustic properties of performance spaces, while reminding us of the need for architects to understand the harmonic properties of music [4]. In the context of the soundsphere, it has been argued that the building itself may become an instrument, coevolving with music, as has been proposed in the case of the evolution of medieval plainsong in the highly reverberant cathedrals to elaborate counterpoint in the less lively churches of the German reformation [5], or musical works designed for the highly specific acoustics of particular buildings [6]. Frances Yates has convincingly analyzed the Elizabethan theater as a carefully constructed and controlled soundsphere, with the actor placed strategically at the acoustic focus of the space [7]. Outside of spaces for music and performance, acoustic spaces within other listening contexts, such as Marin Mersenne's acoustic lenses, Athanasius Kircher's listening machines, and Christopher Wren's Whispering Gallery in St. Paul's Cathedral, all deliberately control, measure, understand, and make use of soundspheres as fundamentally borne of the synchronicity of material and geometric properties [8].

### *Shells: Material and Immaterial*

The first major scientific breakthrough in control of the acoustic environment was Wallace Sabine's 1895 formulation of a mathematical model of reverberation time in relation to spatial volume and surface absorption [9]. For the first time, by linking formal, material and spatial variables to perception, the shape of the soundsphere could be opened to instrumental design. Design of spaces for acoustic performance became a science, but a maddening one: it soon became clear that a solution that works well for one listening need might not work for another. The shell – hard, heavy, and inflexible – offered control but also became a limit (Figure 1, left). Variable acoustic engineering developed highly sophisticated and often cumbersome mechanical and hydraulic systems for adjusting the parameters of concert halls, most notably in experimental facilities such as IRCAM in Paris, SARC in Belfast, or EMPAC in Troy, New York (Figure 1, center). Less flexible (and less costly) versions, offering a smaller range of variability but with more ease of operation, appeared in concert halls, especially those designed for contemporary music. Hung ceilings could be lowered or raised, wall panels rotated to absorptive or reflective surfaces, spaces expanded or contracted with the use of temporary enclosures. Outside the concert hall, the modern world became one of unprecedented noise and brute suppression, aided by the ubiquitous acoustic ceiling tile [10]. As composer R. Murray Schafer put it, in a world in

which "the internal combustion engine provides the fundamental sound of contemporary civilization," the design of the soundscape turned from productive to reactive ideals [11].

As Le Corbusier no doubt understood, technological developments in the electroacoustic production of sound – the invention of the multi-speaker array – made possible the shaping of a soundsphere without the introduction of a hard shell. By varying placement of sound sources, by "moving" sounds from one source to another, by varying volume and, in more sophisticated examples, wave phase, the perceived acoustics of a space could be rendered independent of physical form. The development of hard acoustic shells was accompanied by a contrary movement in which the acoustic envelope was dematerialized. This precisely paralleled the general fascination with the dematerialization of the building envelope in avant-garde architectural discourse in the 1960s and '70s. The clear physical presence of audio equipment in Banham and Dallegret's architecturally reductive Environment Bubble is telling (although the likely unpleasant acoustic conditions inside the bubble have not been considered). Sound artists as divergent in their practices as LaMonte Young, Janet Cardiff, George Bures Miller (Figure 1, right), and Bernhard Leitner are all engaged in the production of these immaterial shells and spheres. So is anyone who has ever worn a pair of headphones while walking down a noisy street, creating a personal, mobile soundsphere, immaterial, invisible, and transient.

**Figure 2. Resonant Chamber prototype: (left) Surface detail. © RVTR. (right) Prototype installation of three operational acoustic clouds. © Peter Smith Photography. Photo by Peter Smith.**

***Resonant Chamber***

Resonant Chamber is an exploration of the acoustic project through computational and prototype-based design research (Figure 2). The work emerges from an interest in the acoustic, spatial, and social possibilities of the acoustic shell as neither material-but-static nor flexible-but-immaterial; a soundsphere that is able to adjust its spatial, material, *and* electroacoustic properties in response to changing sonic conditions, to dynamically alter the sound of a performance space *during* performance, or to become itself an instrument inviting new forms

of performance and play. Utilizing contemporary technologies for computational design, acoustic performance, material testing, digital fabrication, ubiquitous sensing, and real-time micro-actuation, we explore development of a system that might be robust enough, flexible enough, and adaptive enough to move out of the concert hall and make everyday spaces acoustically tunable to changing activities or needs. Through the use of interactive technologies, this flexible prosthetic shell could afford an almost seamless and perhaps even unconscious connection between listener and soundsphere, operating as a second-order cybernetic system.

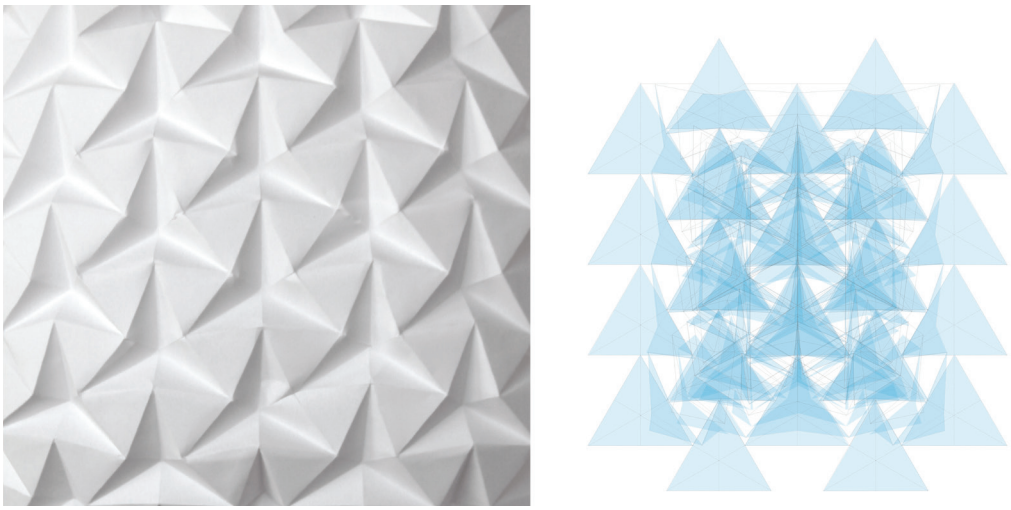


**Figure 3. Rigid origami geometry and flat folding logic drawing. © 2012 RVTR.**

***Dynamic Surface Geometries***

The first constructed prototype of Resonant Chamber is designed as an installation of a thick kinetic surface, transformable through the geometric properties of rigid origami. Rigid origami was explored as a flexible geometric system, as it makes it possible to achieve predictable spatial configurations through its surface properties of developability (folded from a single sheet), flat-foldability (ability to fold into a flat shape), and degrees of freedom (DOF) [12]. The origami-based geometry allows both for gross deformation of the surface to dynamically alter the aural volume's overall spatial form, as well as localized manipulation to vary the ratios of exposed surfaces with variable material (and therefore acoustic) properties and linkages.

Previous work by the authors in responsive envelopes has explored cable-strut tensegrity weaves as a lightweight, distributed structural framework that would be able to support kinetic deformation [13]. Rigid origami offers different advantages: as a result of the interconnected reactions between interior vertices and crease lines, which determine the DOF of the surface, physical actuation in one location has calculable effects on adjacent elements, thus reducing the number of points of actuation required to induce overall formal adjustments. The property of flat-foldability optimizes angles around a central vertex to allow the surface to tuck, enabling compact deployable structures within a limited space. Rhinoceros 4.0 software, and Grasshopper and Kangaroo plug-ins, were used to script and accurately simulate the relationship among geometries and gravitational and applied forces. This computational software will also allow us to develop different folding patterns that can be customized to suit a variety of spaces, potential aural volumes, and uses. The Resonant Chamber prototype uses a tessellated pattern first developed by Ron Resch [14], which deploys two sizes of triangular cells (Figure 3). This specific cell geometry, prototyped in bamboo plywood, was chosen as it proved to be most acoustically sensitive in a series of comparative tests evaluating performance of formal and material configurations, as well as integration with electroacoustics (Figure 4).

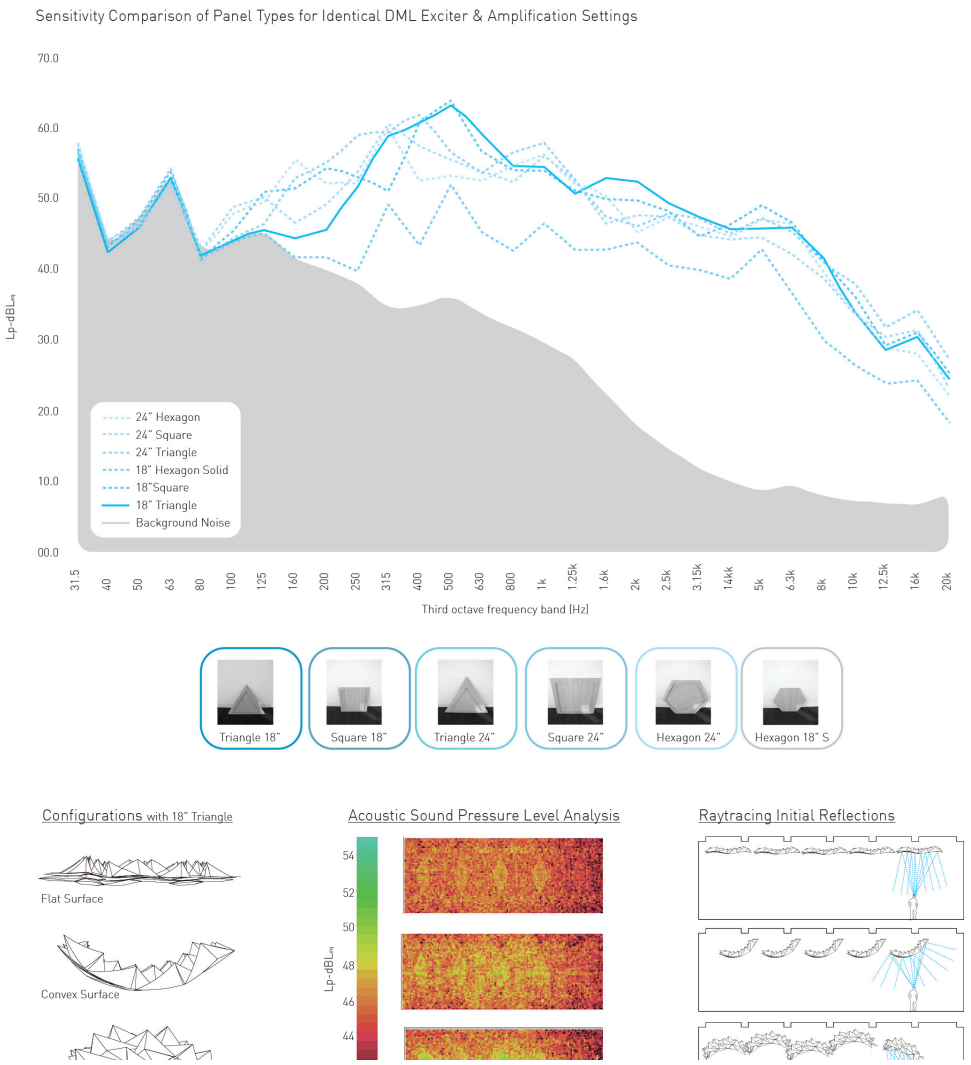



**Figure 4. (above) Acoustic sensitivity comparison of panel shapes for identical DML exciter and amplification settings (chosen is the dashed line: 18" triangle); (below) Acoustic sound pressure analysis and acoustic reflections of surface configurations. © 2012 RVTR.**

### *Performative Material Systems*

Flat-foldability relies on the fundamental physical property of optimum zero thickness, as is the case with paper origami; to shape acoustic performance, however, materials with multiple thicknesses, three-dimensional profiles, and specific properties are necessary. Three parallel streams of development were necessary for this translation into a performative surface. First, joint details were developed that would allow for the flat-folding of thick surfaces [15]. This included material prototyping with laminated membrane hinge assemblies and development of panel profiles for folding. Second, three primary types of panel composites were developed to absorb, reflect, or elecroacoustically generate sound (Figure 5). Third, suspension and actuation technologies were prototyped that would allow the surface to be physically deployed within a space, and for its facets to move, either in response to sensor inputs or in pre-programmed modes (Figure 6).

The reflective, absorptive, and sound-generating panel types that comprise the material characteristics of the system were developed in collaboration with consultants at ARUP Acoustics. Digital acoustic simulations and physical panel prototype testing were undertaken to determine optimal geometry and material characteristics relative to acoustic performance

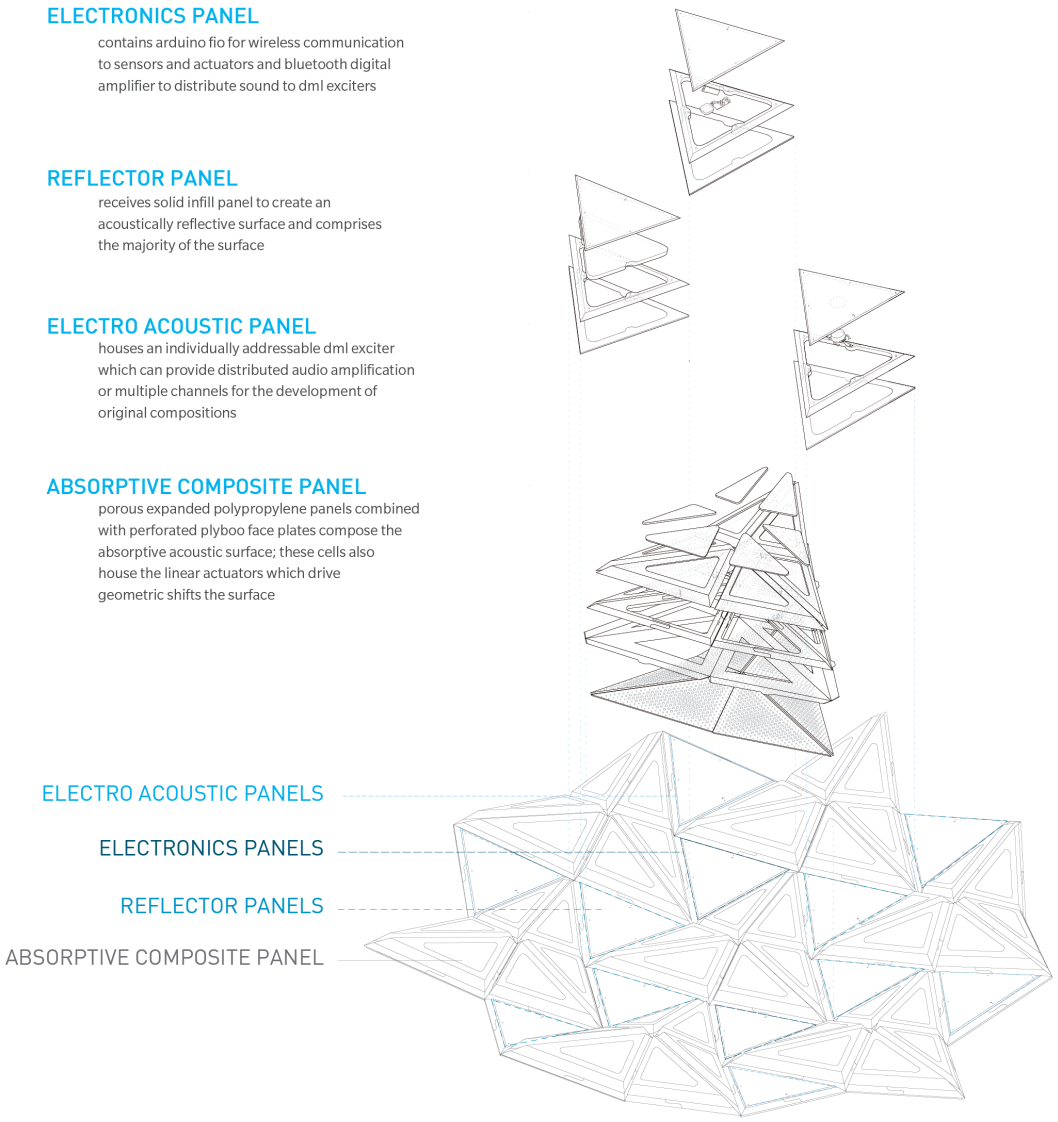
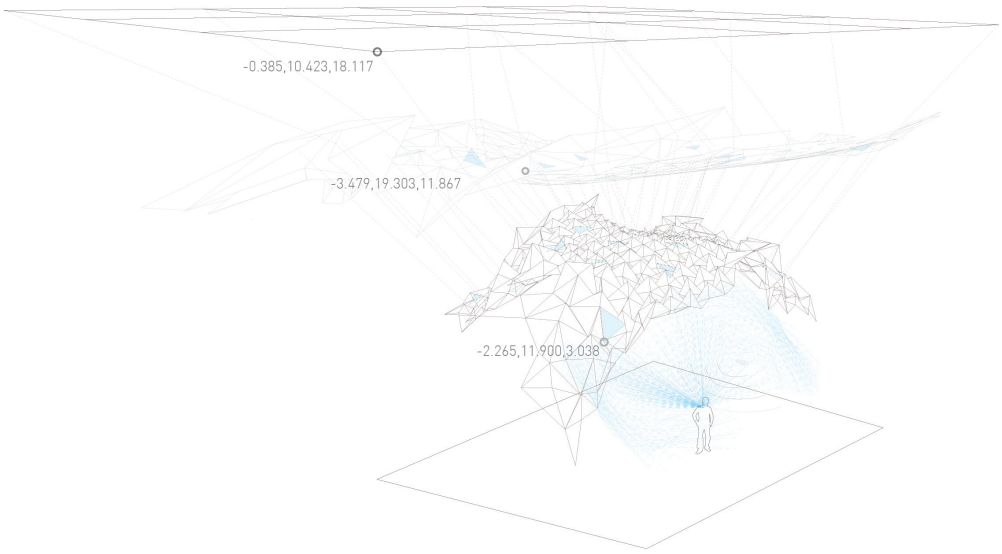
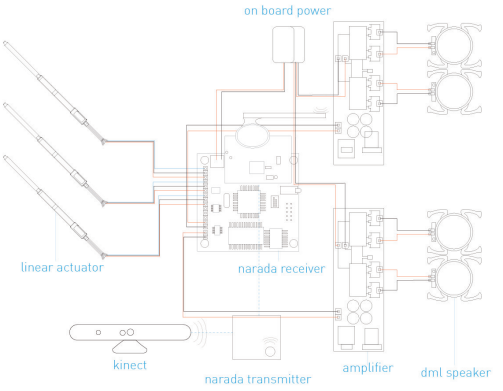



**Figure 5. Composite panel assembly and materials. © 2012 RVTR.**

when combined with the proposed geometric configurations and electroacoustic technology (Figure 7). The sound-generating panels have Distributed Mode Loudspeaker (DML) exciters embedded within their composition, effectively turning these panels into speakers. Although the integration of DMLs into a multichannel system has been realized successfully in the past [16], their integration into a kinetic surface has not been widely explored and opens up an array of possible applications. On one hand, the DMLs provide an augmented level of reverberation control and directional sound reinforcement, which can now be actively manipulated for greater acoustic control. On the other hand, they comprise an entirely different interactive interface from the spatial-material control approach of the physical system, opening up a variety of possibilities for interactive sound installations, immersive live performance spaces, or acoustically enhanced learning facilities. Resonant Chamber thus has the possibility to become a hybrid architecturally scaled instrument, a dynamic aural environment that not only facilitates performance, but also might perform itself.




Wiring Network

Sensors:
- Audio signal / two DML speakers (stereo)
- Position feedback / one hoist panel
- Occupancy feedback / one kinect
- Audio feedback / one amplifier

Actuation:
- Suspension length position / one stepper
- Stroke length position / one actuators

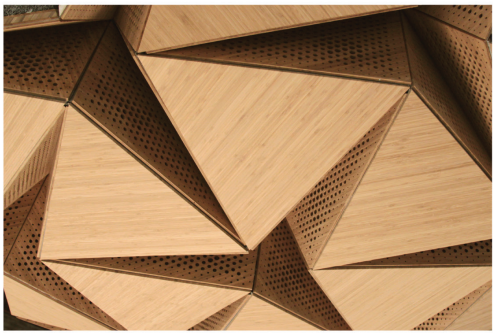


**Figure 6. (above) Variable surface configuration through folding properties; (below left) circuit diagram and wiring network; (below right) wiring of prototype surface with actuators from above, and folded surface from below. © 2012 RVTR.**

### *Variable Actuation and Response*

A series of linear actuators mechanize the folding motion of the Resonant Chamber surface, locally varying material exposure for optimum acoustical tuning (Figure 8). A track system of stepper motors provides gross-motor positioning of the system within the space. Currently, Arduino micro-controllers are used to manipulate localized folding movements. Commands tied to the digital surface model communicate data via the Firefly software plug-in to calculate and coordinate desired movements. For the next prototype, we are collaborating with Jerome Lynch at the University of Michigan to incorporate into the assembly his Narada® system for wireless sensing, actuation, and on-board data processing.

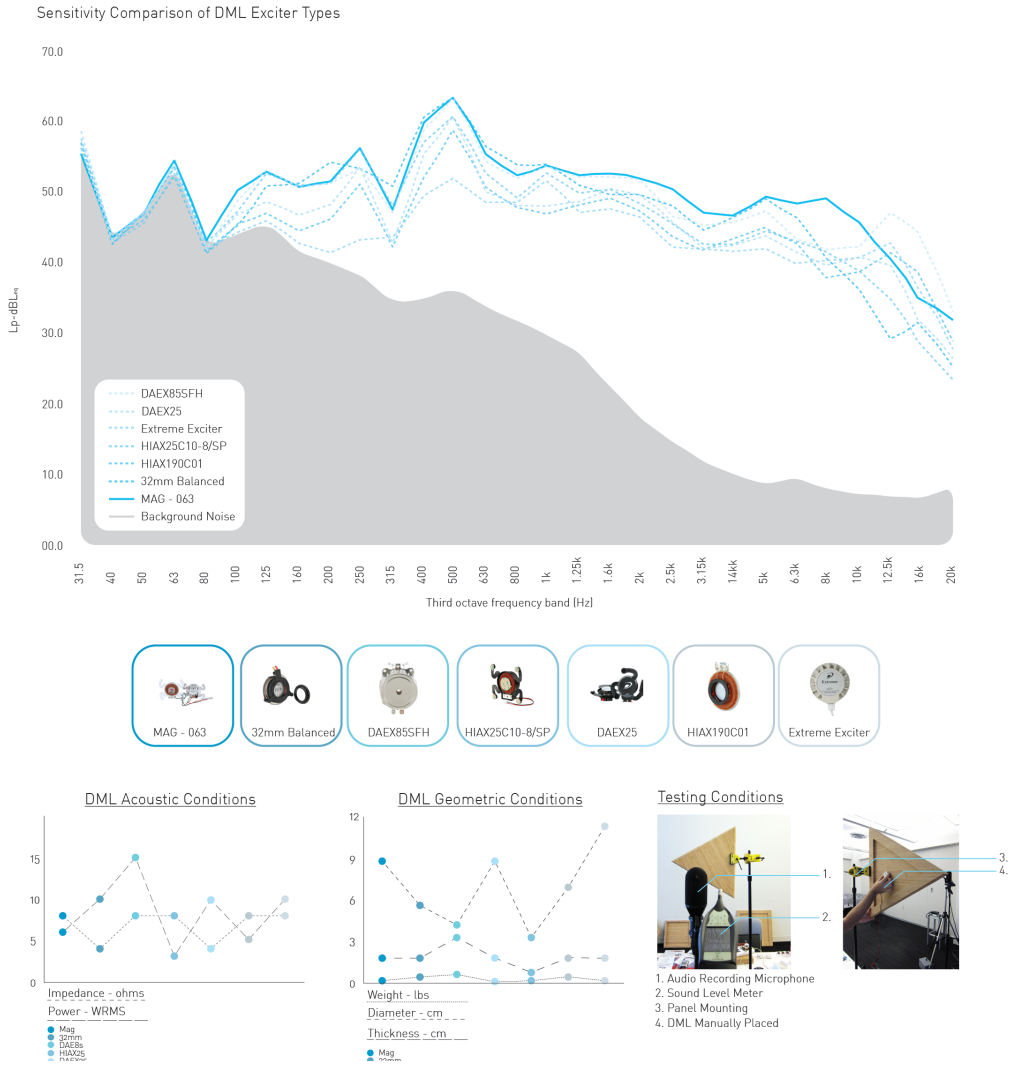



**Figure 7. Physical sensitivity comparison and testing of DML exciter types with panel (chosen is the dashed line: MAG-063).**
**© 2012 RVTR.**

The synchronized actuation systems will allow geometric optimization for early acoustic energy and alter surface material exposure for late acoustic energy. Early acoustic energy controls the acoustics occurring shortly after the direct sound at both a listener and performer location by adjusting the height, location, and curvature of the prototype. Late acoustic energy controls diffusion and reverberation by adjusting the absorption material exposure, size, and location of the prototype. Though there are precedents for control of late room response through the use of systems to manipulate height or orientation of a ceiling reflector [17], the use of a kinetic system to control wavefront curvature, level and time of arrival of early reflections constitutes a new advance in acoustic research.

In order to explore sensing and response, the installation space will be equipped with frequency, volume, and acoustic pressure sensors, which will process audio input in order to trigger physical and/or electroacoustic responses. Devices such as the Kinect sensor will locate the presence of people within the space and trigger transformations of the Resonant Chamber surface relative to location, number, and activity of occupants. Interaction modes will vary from tuning acoustics for specific performances to pattern languages that develop machine learning and cognitive responses relative to both actions and sounds of occupants.

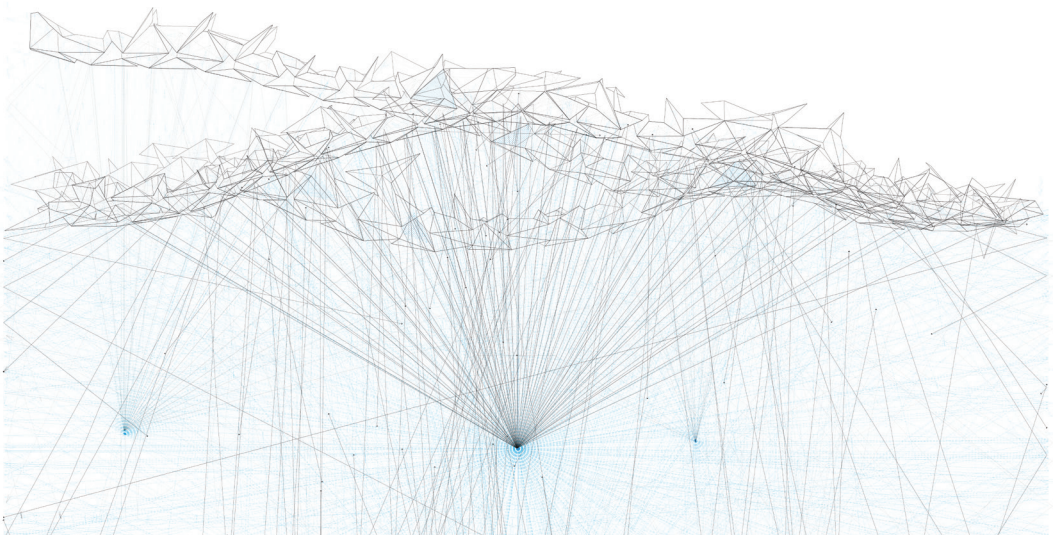


**Figure 8. Resonant Chamber: ray-tracing of acoustic reflections due to variable spatial configurations delivered through gross displacement. © 2012 RVTR.**

***Projection***

Resonant Chamber is currently in its second phase of research and prototyping, which will allow for refinement of material and technological components and performance, as well as for testing relative to human interaction and feedback. We will also be refining sensing and control regimes with regard to how the system might be deployed in a variety of spaces and uses – prioritizing, for example, particular aural qualities to enhance various configurations of live musical performance, blending aural and occupancy feedback to reconfigure the relationships between audience and performer, or developing individual need-based recognition systems that could dynamically recalibrate learning environments relative to inhabitant's aural ability – and assessing real-world manufacturing and installation issues. Resonant Chamber, in its aspirations to combine kinetic spatial reconfigurability, multiple surface material properties, electroacoustics, and interactivity, thereby produces a system of incredible complexity, both functionally and operationally. This is both its attractiveness and its limit. As an engineering problem to be solved, the adaptive system of such complexity is inherently difficult to predict and control, and its many moving parts are prone to failure and mechanical difficulties. However, the work makes a case for the territory within which the architectural project of the soundsphere may be located in our contemporary context – as a hybrid investigation of material, electronic, and human-interactive environments.

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**References**

1. M. McLuhan, "Inside the Five Sense Sensorium," *The Canadian Architect* Vol. 6, No. 6, 50 (1961).
2. M. Treib, *Space Calculated in Seconds: The Philips Pavilion, Le Corbusier, Edgard Varèse* (Princeton: Princeton University Press, 1996).
3. H. Bagenal, "Influence of Buildings on Musical Tone," *Music & Letters* Vol. 8, No. 4, 439–441 (October 1927).
4. H. Morgan, ed., *Vitruvius: The Ten Books on Architecture* (New York: Dover Publications, 1960).
5. Bagenal, 442–443.
6. H. Bagenal, "Bach's Music and Church Acoustics," *Music & Letters* Vol. 11, No. 2, 146–155 (April 1930).
7. F.A. Yates, *Theatre of the World* (Chicago: University of Chicago Press, 1969).
8. M. Crunelle, "Is There an Acoustical Tradition in Western Architecture?" *First International Conference On Acoustic Ecology* (1993), www.wseas.us/e-library/conferences/skiathos2001/papers/102.pdf (accessed March 10, 2012).
9. E. Thompson, *The Soundscape of Modernity: Architectural Acoustics and the Culture of Listening in America, 1900–1933* (Cambridge: MIT Press, 2002).
10. Thompson, Ibid.
11. R.M. Schafer, *The Tuning of the World* (New York: A. A. Knopf, 1977).
12. K. Velikov, et al., "Toward Responsive Atmospheres: Prototype Exploration Through Material and Computational Systems," *Integration through Computation: Proceedings of the 31st Annual Conference of the Association for Computer Aided Design in Architecture (ACADIA)* 2011, 326–333 (2011).
13. J. O'Rourke, *How to Fold It: The Mathematics of Linkages, Origami and Polyhedra* (Cambridge: Cambridge University Press, 2011).
14. R. Resch, "The Topological Design of Structural and Architectural Systems," *AFIPS Conference Proceedings* Vol. 42, National Computer Conference (1973).
15. T. Tachi, "Rigid-Foldable Thick Origami," *Proceedings of 5OSME*, Singapore (2010).
16. E. Corteel et al., "Objective and Subjective Comparison of Electrodynamic and MAP Loudspeakers for Wave Field Synthesis," AES 30th International Conference (2007).
17. V.M.A. Peutz, "The Variable Acoustics of the Espace de Projection of IRCAM," *Proceedings of the 59th AES Convention* (1978).

# Within an Ocean of Light: Creating Volumetric Lightscapes

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**ABSTRACT**

**This paper documents explorations into an alternative platform for immersive and affective expression within spatial mixed reality installation experiences. It discusses and analyzes experiments that use an advanced LED cube to create immersive, interactive installations and environments where visitors and visuals share a common physical space. As a visual medium, the LED cube has very specific properties and affordances, and optimizing the potential for such systems to create meaningful experiences presents many interlinked challenges. Two artworks exploring these possibilities are discussed. Both have been exhibited internationally in a variety of settings. Together with this paper, the works shed some light on the design considerations and experiential possibilities afforded by LED cubes and arrays. They also suggest that LED grids have potential as an emerging medium for immersive volumetric visualizations that occupy physical space.**

## Introduction

With *Light-Space-Modulator* (1922-30), László Moholy-Nagy is often cited as bringing together for the first time "all the fundamental elements of twentieth-century art: [...] space and movement, perception, experimental machinery and viewer participation" [1]. By the mid-1960s, the legacies of Futurism, Dada, Constructivism, the Bauhaus, and elements from other art movements had cross-fertilized to produce what would eventually become installation art [2]. Minimalism was altering the relationships among audience, work, and the space in which it is seen [3]. Simultaneously, James Turrell, Robert Irwin and other "light and space artists" were using the materiality of light, space, and time to create immersive phenomenological experiences, often with no physical component, or *object*, as central focus [4] – a trend still developing today with artists such as Olafur Eliasson. This lack of physicality has clear resonances with the digital paradigm, from the virtual art of the '80s and '90s to recent explorations of pervasive augmented reality and mixed reality [5] experiences. The relationship and interplay between the digital and the physical, the tangible and the intangible, has been of fundamental interest to digital art, particularly the area of digital or mixed reality installation art [6].

Though explored in numerous ways, installation techniques using light and space are even now predominantly screen-, or projector-, based. Such works are well documented, and their relationships to the spaces, people and architectures in which they exist have been analyzed from various perspectives, from the social [7] to the perceptual, spatial, and architectural [8]. Numerous media artists have also explored the use of large-scale dynamic architectural lighting, appropriating technologies and techniques from concert stage lighting, signage, and architectural media façades to produce architectural-scale experiences. This focus on controlling light as it relates to physical structures and within real space has also tantalized with the possibility of creating visual impressions that are *three-dimensional and dynamic*, that *occupy physical space*, and that *can be seen from any angle* yet are also highly ephemeral and retain the abstract phenomenological approach of light and space art experiences.

Various forms of holography and stereoscopy attempt to fulfil these requirements, but they do not occupy *physical* 3D space, and they have various constraints of their own. Another technique

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currently in vogue is projection mapping: the use of bespoke media projected onto physical objects and buildings with the aim of augmenting and altering perception of those objects and spaces [9]. Though still not occupying physical space, this approach is at least located clearly within physical space. An emerging alternative is to configure individually addressable LEDs (light emitting diodes) into three-dimensional arrays – so-called LED cubes (Figure 1). Such systems have significant limitations as a visualization tool but they occupy physical space in a literal way, defining volumes of the same space that we inhabit.

This paper aims to shed light on some of the design considerations and experiential possibilities afforded by such LED cubes or grids, as they offer increasing potential for visualization techniques that occupy three physical dimensions. It follows the development of two artworks by digital arts group Squidsoup [10], developed as part of a practice-led [11] research project exploring the possibilities afforded by this medium using a research-through-design methodology [12]. Both artworks were built on an advanced LED cube, *Ocean of Light*, explore ways in which such systems can be used to augment reality in new and interesting ways, and assist in the task of finally doing away with the "tired dichotomies of digital versus analog, real versus virtual" [13], while retaining the power and flexibility of the digital domain.

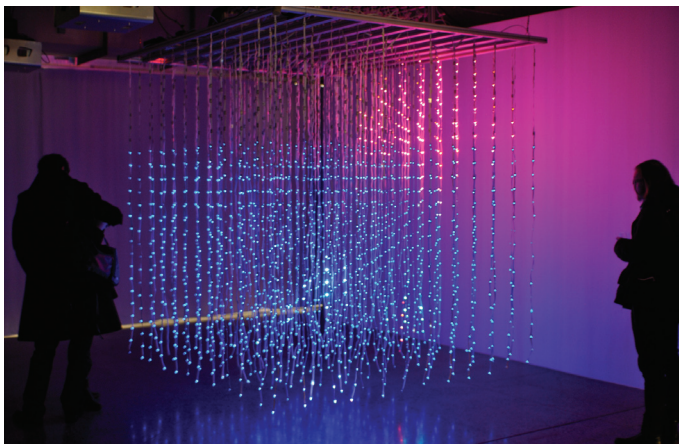

**Figure 1. *Ocean of Light*, an advanced LED cube. Electronics, 2.5m x 2.5m x 2.5m, 2010. © 2011 Squidsoup.**

### LED Cubes

To create the illusion of representation of form, advanced LED cubes or grids use the same technique as flat screens. They rely on the brain accepting that disparate points of light form a cohesive whole where visual representations can move from one point to the next, by careful control of the light emitting from each point [14]. The main design difference between screens and 3D grids is that when they are constituted in three dimensions, one needs to be able to see beyond each layer to the ones behind. This requires transparency, or gaps between the points of light to reduce occlusion.

Little formal research has been done on the design and build of such systems beyond the technical [15], although prominent realized projects by architecture and design companies such as United Visual Artists (*Volume*, *Constellation*), Jason Bruges Studios (*Pixel Cloud*) and rAndom International (*Swarm*) show that practical examples exist, and that this approach is beginning to enter the public consciousness. However, most of the developments in these works have focused on the physical hardware and the aesthetics of the physical objects that constitute the grid of lights, rather than the content they display.

An underlying premise of this paper is that such structures are effectively heralding a new medium with its own properties and affordances. This medium can be used in different ways, but of particular interest here is the creation of immersive environments, rather than representing objects seen from without.

### *Ocean of Light*

In *Ocean of Light*, the three-dimensional grid of LEDs used to convey the experiences discussed below, Squidsoup seeks to create immersive visual experiences that become a part of the environment. As most LED grids are designed and positioned to be seen as objects in their entirety, from a distance (and often from below), a re-thinking of the physical relationship between object, viewer, and space is required. This alternative approach requires viewers to be able to get very close to, even within, the LED space. The cube must therefore be proximal, accessible, and touchable. It is also desirable to maximize the distance between LEDs and to minimize each unit's size – to be able to see through the LED space, to create space among the LED units, and to blur the boundaries of the cube, calling to mind the *pénétrables* works of Jesús Rafael Soto [16]. This approach to the design of the physical structure differs significantly from the norm, where lights are larger and more densely positioned (see, for example, the NOVA LED display by ETHZ, or the works mentioned above).

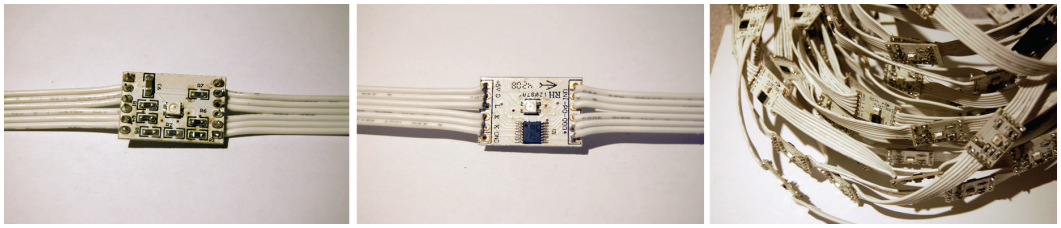

**Figure 2. Detail from *Ocean of Light*: a suspended LED pair front and back, and an LED string. © 2010 Squidsoup.**

*Ocean of Light* has 3,456 individually addressable points of light arranged in a 12 x 12 x 24 (high) grid. The lights are suspended from an aluminium rig in strings containing 24 LED pairs, each light consisting of two naked tri-color LEDs emitting a tiny 1mm-diameter point of light (Figure 2) in opposing directions (so as to be visible from any angle). This setup suffers little from occlusion, but does have a particular visual aesthetic. Additionally, small points of light are less revealing of their physical location – they do not perceptibly shrink with distance – requiring viewers to move in order to receive clear depth cues.

The wires connecting the strings are flexible, pliable but retaining bends, resulting in an irregular grid structure (Figure 3). The Moiré effects so prominent in regular grids (see for example Erwin Redl's work) thus become less dominant, giving the structure a more organic aesthetic.

The distance between each string can be altered, from 10cm to 20cm. Vertical pitch is fixed at 10cm, meaning that at its largest the grid occupies a 2.4m cube. At this size, the space between each string (20cm) is large enough to stick an arm or a head inside, and the physical electronics occupy only a small percentage of the volume within the grid.

### Technical Setup

By appropriating video wall technology and reconfiguring the standard 2D screen grid into a series of sheets placed behind each other, it was possible to develop a simple screen-based programming approach to producing volumetric visualizations by slicing up 3D shapes on screen, which are then reconstituted in the grid. Screen pixels are allocated to individual LEDs within the grid, so a much more visual development process was possible, as designs can be developed to a large extent on a standard screen. This meant that early tests and experiments could be performed by visual designers as well as coders (see Figure 4).

Dynamic experiments were also simplified using this approach, as changes and refinements can be seen on-screen without the constant need to be connected to the cube. This, combined with

the low resolution of the content, meant that rapid prototyping was possible using any screen-based software. Processing and Adobe Flash both worked well and were used to develop content for the project.

### Experience and Perception

The phenomenological effects of *Ocean of Light* were noticeably stronger when spread over a larger area – the visualizations appeared more immersive and more powerful. At larger sizes, it becomes much more of an environment, i.e. occupying a significant volume, rather than an object, as represented by the smaller version. Interestingly, the distance between the strings (at least up to 20cm) does not add perceptibly to our ability to connect adjacent points of light. The overall visual experience is definitely still one of a volume rather than a series of columns of light, a volume where digital entities within have scale, position, and presence within our physical world. Also, as an environment situated within our world, it does not involve any kind of locative disjunct, or window-into-another-world metaphors, that build perceptual boundaries between the perceiver and the perceived [17]. Finally, its abstract visual qualities have many advantages, among which are a clear distance from any attempts at mimicking reality, an ability to captivate and dominate physical space through its luminous qualities, and the need to be relatively unspecific and open to interpretation.

**Figure 3. The irregular features of *Ocean of Light*. © 2010 Squidsoup.**

### Content and Designs

Two contrasting artworks were developed for the *Ocean of Light* hardware. Both use forms derived in real time from a combination of generative and interactive stimuli but develop the potential of the medium in different ways, to create different visual and affective outcomes. Discussion of the works, entitled *Surface* and *Scapes*, follows.

#### *Surface*

*Surface* is a responsive virtual eco-system that occupies physical space [18]. It uses the hardware as a 3D canvas to visualize movement in physical space. The space is dominated by a surface – the boundary between two fluid virtual materials. The materials are affected by sound in the real world, whereby nearby noises create waves that ripple across the surface. These fluids are, however, unstable: the turbulence caused by physical sounds also triggers luminous blasts. Abstract autonomous agents, whose movements are inspired by dragonfly flight patterns, are aware of their surroundings as they navigate and negotiate the environment and the surface (Figure 5).

They also make sounds that affect both physical and virtual spaces. Thus, physical and virtual worlds are intertwined and interconnected; changes in either space affect both.

The paring down of the visuals to striking ultra-simple components (a fluid surface and one to four dragonfly agents) meant that despite the resolution issues, the piece was instantly recognizable as an eco-system with specific and clear components. This is a significant departure from much other volumetric work using 3D grids, where abstract patterns, color cycling, and moving planes are the norm.

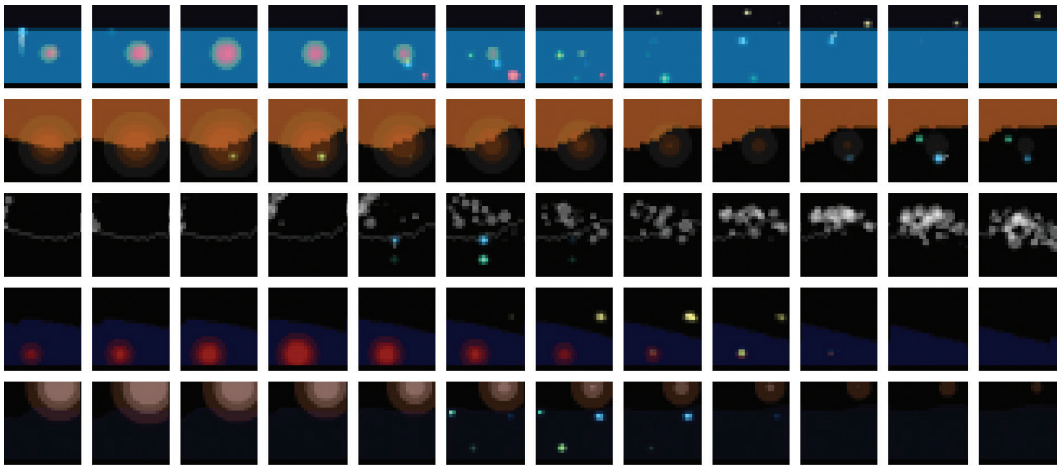

**Figure 4. Five examples of volumetric visualizations broken down to a series of 12 vertical planes, which are then physically placed behind each other. © 2010 Squidsoup.**

*Surface* was first exhibited at Kinetica Art Fair (London, 2010) in a small (4m x 3.6m) space with black walls and a single access point, leaving less than a 1m corridor for visitors. This, combined with high visitor numbers, meant that people were in very close proximity to the work. The effect was highly immersive and visceral, with people becoming mesmerized and disoriented by the work. The boundaries of personal space [19, 20] were challenged, creating a very intimate setting where visitors are almost forcibly inserted into the environment, triggering strong phenomenological reactions to the conditions.

Subsequent exhibitions at the Ars Electronica festival and museum (September to December 2010, Linz, Austria) had a different ambience. The work was set in a much larger and calmer space, allowing visitors to experience the work in a manner more under their control. The experience (judging from responses) was not as viscerally powerful, but it had a contemplative edge that was still able to draw people in for extended viewing periods.

### *Scapes*, or "Paysages de Lumière"

> *Scapes* conjures into being three-dimensional cities, landscapes and abstract architectures purely from sound, software and light. Chimaera-like visions of ephemeral spaces are created and destroyed in real time. They occupy physical space, but only fleetingly. They leave nothing behind when they, and the sounds that spawned them, vanish. [21]

*Scapes* was the result of a tripartite co-design ecology combining music, programming, and light. Sound design, dynamic movement patterns, and vectors derived from tuned Fast Fourier Transforms (FFTs) were the materials used to create parametric volumetric forms that could be manipulated and visualized in real time. An iterative design process evolved where the final aesthetic results were achieved through designing and altering the relationships between these

materials. The system is completed by a feedback loop that uses a microphone to take ambient sound from within the gallery space (including the sound composition that forms the basis of the work) back into the same designed set of software filters, thus affecting the visual forms once again. The resulting system can therefore be intercepted, corrupted, and significantly altered in real time by visitors making their own sounds to interfere with the original audiovisual designs.

This process was performed on numerous initial sketches, each starting from a visual, coding, and/or musical idea. The sketches were whittled down to a suite of five scapes – "*paysages de lumière*" (Figure 6). The name derives from the notion running through all five pieces of creating representations of vistas or landscapes. The landscapes represented a waterfall suspended in time, an abstracted cityscape with skyscrapers and a bustling ground level, the slow inexorable power of an ocean wave, passing scenery watched through a car windscreen in the rain, and the moon under duress.

*Scapes* was first shown at Tenderpixel, a small and intimate art gallery in Central London, and subsequently in a large black box at Scopitone, an experimental music and art festival in Nantes, France.

#### Reflections on Exhibition Space and Physical Considerations

In a perfect world, *Scapes*'s would be invisible and the lights everywhere. We used various methods to enhance the illusion of volumetric form and reduce the visibility of the technology (strings, LEDs, support structures). Of particular note was the use of fabric as a semi-transparent veil in *Scapes*. Taut Lycra has curious optical properties, blurring what is behind the veil, and also obscuring whatever comes through the material at an angle. The result has a chimeric quality, reminiscent of the illusion of a dream, or a memory of what once was. Blurred points of light forming defined 3D shapes are clearly visible, but all else (electronic and other paraphernalia) recedes to near-invisibility.

These aesthetic properties were clearly appropriate for *Scapes*. However, the use of a fabric veil, in effect a boundary, calls into question the conceit of moving away from screen-based techniques and also counters the aim of blurring the borders between accessible space and the grid of LEDs. The Lycra forms a screen – a 2D surface that (it can be argued) makes whatever is beyond it a flat visualization, and beyond reach. This takes the project a step back from physicality, and produces another boundary between the virtual world of *Scapes* and the physical world in which it exists. But at an experiential level, the piece seems surprisingly more convincing as a result of the veil, the visual ambiguity proving at least as attractive as the screen is distancing.

Both pieces were shown in various spaces and situations. The size of the exhibition space has a strong effect on immersion; smaller spaces that coerce participants into being nearer the work than they would otherwise choose to be create a significantly more powerful experience. This feeling is reinforced by the use of dark walls, as they are less visible and so do not distract from the

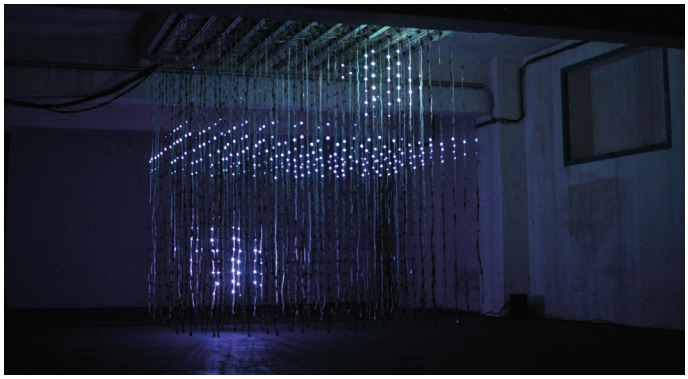

**Figure 5. *Surface* (at Ars Electronica Festival, September 2010), showing a dynamic surface and two autonomous agents. © 2010 Squidsoup.**

work. In a small, dark space, the work has an affective quality, appealing directly to multiple senses through, for example, light and electrostatic radiation that can be sensed on the skin. Additionally, a feeling of sensory overload is more likely, as the visuals cover the viewer's complete visual field. Larger exhibition spaces allow for a distance that, by enabling a clearer impression of the work as a whole, also creates an intellectual barrier to visceral immersion.

One of the stated aims of the *Ocean of Light* project was to move away from the grid presenting the appearance of an object and toward integrating the grid with the local environment. When placed in a small room, the grid cannot be seen as an object; it appears to occupy all available space, confined only by the room it is in. However, the use of larger spaces, and also the Lycra diffusing barrier used in *Scapes*, creates other impressions. The abstraction gained from the veil and the ability to get very different impressions from viewing the work from different distances fundamentally alter the overall experience.

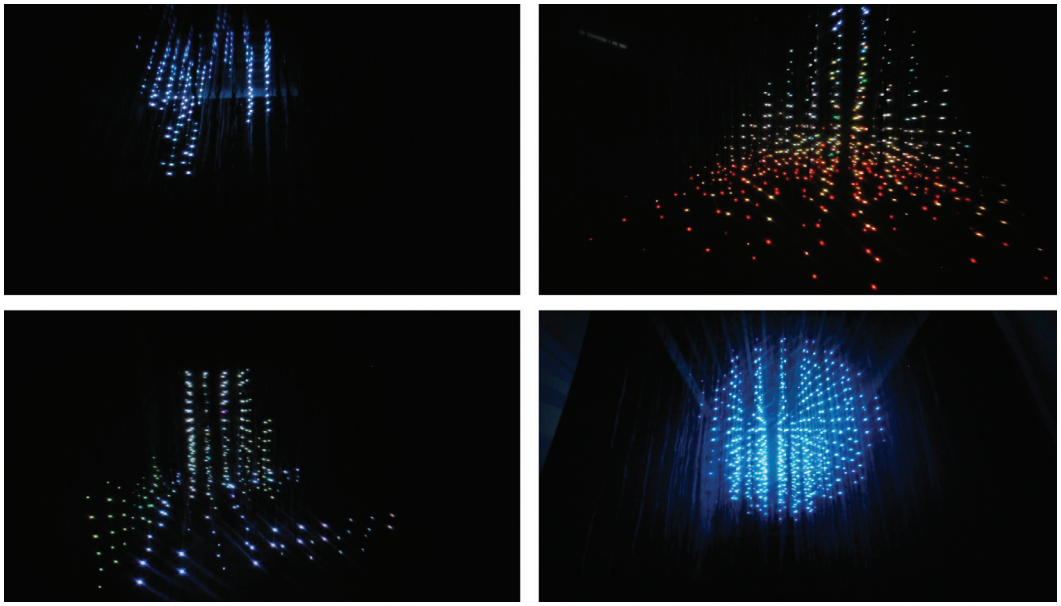

**Figure 6. *Scapes* – example "paysages de lumière" (at Tenderpixel, London, 2011). © 2011 Squidsoup.**

## Conclusions

The two contrasting pieces described here were designed in part to evaluate the effectiveness of an advanced LED cube as a platform for creating a range of visual impressions, from the visceral, entangled immersion of *Surface* to the tranquil, beguiling, enfolding qualities of *Scapes*. These examples suggest that this emerging medium can be effective at creating experiences that immerse participants and give the impression of presence in three-dimensional physical space. They also have a clear ability to bring virtual worlds into the physical in new and different ways.

The visual effect of these pieces is fairly abstract (due in part to the constraints of low resolution) but definitely three dimensional, and it clearly illustrates movement, form, and presence. Resolution is partly a size issue; future work with larger grid environments that are more easily penetrable will increase this effect and, it is anticipated, also heighten immersive potential.

Finally, it is also clear that the design of the space in which the experience is to occur is crucial. The particular attributes of the space – its size relative to the LED grid, the available space between participant and grid, wall color, and so on – all have a fundamental effect on the balance of prominence between virtual and real components of such mixed-reality experiences.

These factors must be taken into consideration when designing such projects, as the balance between real and virtual defines the overall user experience.

**Acknowledgements**

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**References**

1. A. Lütgens, "Twentieth-Century Light and Space Art," *Olafur Eliasson: Your Lighthouse: Works with Light 1991–2004* (Ostfildern: Hatje Cantz, 2004).
2. N. De Oliveira et al., *Installation Art* (London: Thames and Hudson, 1994) 14.
3. R. Morris, "Notes on Sculpture," *Artforum* (February and October 1966), reprinted in G. Battcock, ed., *Minimal Art: A Critical Anthology* (New York: E.P. Dutton, 1968) 222–235.
4. J. Butterfield, *The Art of Light and Space* (New York: Abbeville, 1993) 8.
5. P. Milgram & F. Kishino, "A Taxonomy of Mixed Reality Visual Displays," *IEICE Transactions on Information Systems*, Vol. E77-D, No. 12 (1994).
6. C. Paul, *Digital Art* (London: Thames and Hudson, 2003) 71–72.
7. S. Snibbe & H. Raffle, "Social Immersive Media: Pursuing Best Practices for Multi-user Interactive Camera/Projector Exhibits," *Proceedings of ACM CHI 2009 Conference on Human Factors in Computing Systems* (Boston: ACM, 2009) 1447–1456.
8. S. Lavin, *Kissing Architecture* (Princeton: Princeton University Press, 2011).
9. For example, see P. Dalsgaard & K. Halskov, "3D Projection on Physical Objects: Design Insights from Five Real Life Cases," *Proceedings of ACM CHI 2011 Conference on Human Factors in Computing Systems* (New York: ACM, 2011) 1041–1050.
10. Squidsoup, www.squidsoup.org/.
11. C. Frayling et al., *Practice-based Doctorates in the Creative and Performing Arts and Design* (Lichfield, UK: UK Council for Graduate Education, 1997).
12. B. Sevaldson, "Discussions & Movements in Design Research: A Systems Approach to Practice Research in Design," *FORMakademisk* Vol. 3, No. 1, 8–35 (2010).
13. C. Salter, *Entangled: Technology and the Transformation of Performance* (Cambridge: MIT Press, 2010) xxxiii.
14. A. Rowe & A. Morrison, "Dynamic Visualisation in Three Physical Dimensions," *Digital Arts and Culture* (2009).
15. S. Schubiger-Banz & M. Eberle, "The NOVA Display System," *Transdisciplinary Digital Art: Sound, Vision and the New Screen* (Berlin: Springer, 2008) 476–487.
16. T. Cuevas, H. Obrist, & P. Santoscoy, *Jesús Rafael Soto: Visione in movimento* (Milan: Silvana Editoriale, 2007).
17. S. Feiner, et al., "Windows on the World: 2D Windows for 3D Augmented Reality," *UIST '93 Proceedings of the 6th Annual ACM Symposium on User Interface Software and Technology* (New York: ACM, 1993).
18. Squidsoup, *Surface*, www.squidsoup.org/surface/.
19. E.T. Hall, *The Hidden Dimension* (Garden City, New York: Doubleday, 1966).
20. C. Randall & A. Rowe, "Come Closer: Encouraging Collaborative Behaviour in a Multimedia Environment," Interactive Technology and Sociotechnical Systems; 12th International Conference, VSMM 2006, 281–289 (2006).
21. Squidsoup, *Scapes*, www.squidsoup.org/scapes/.

**Cézanne Charles**
Artist, curator, and writer Cézanne Charles is the director of creative industries for ArtServe Michigan and former executive director of New Media Scotland. She has commissioned, curated, and presented talks, research, and works by creative practitioners who are exploring the implications of emerging technologies and scientific developments in contemporary culture in both the US and the UK. She co-founded rootoftwo with John Marshall — a hybrid art and design studio that uses electronics and digital media to explore interactions among audiences, objects, and sites. They have presented work in the US, Europe, Japan, Australia, Brazil, and China. She was art committee chair for the Detroit Institute of Arts Friends of Modern & Contemporary Art fundraiser Sync: Art Meets Technology at Next Energy (2011); and a juror and member of the curatorial committee for BioLogic: A Natural History of Digital Life, an exhibition of international artists at SIGGRAPH 2009 in New Orleans. In 2006, she co-curated Perimeters, Boundaries and Borders, an art, design, and technology exhibition.

**Nick Hasty**
Nick Hasty is an artist, programmer, writer, consultant, and musician. He currently serves as director of technology for Rhizome at the New Museum. He has presented on digital preservation and internet art at SXSW Interactive, Internet Week NYC, and ISEA. As an artist, he uses sound and networked technologies to reflect on contemporary culture and plays drums and electronics in the avant-rock band Source of Yellow. He received a BA in English literature from the University of Georgia and a master's degree from New York University's Interactive Telecommunications Program in the Tisch School of the Arts.

**Mona Kasra**
Mona Kasra is a new media artist and educator, currently pursuing a PhD at the University of Texas at Dallas with a focus in arts and technology. Her research is centered around the impact, power, and politics of the image in the digital networked era. She is especially interested in ways by which digital images, coupled with social media technologies, reconstruct the extent of public awareness and action against unjust sociopolitical affairs around the world. She holds a BA in graphic design and an MFA in video and digital art, and has shown work in many exhibitions in both gallery and online settings. She served as the Art Gallery Chair for SIGGRAPH 2011.

**Osman Khan**
Osman Khan is an artist interested in constructing artifacts and experiences for social criticism and aesthetic expression. His work plays with and subverts the material and media behind themes of identity, communication, economics, and public space through participatory and performative installations and site-specific interventions. In 2004, he completed his MFA at the Department of Design | Media Arts, University of California, Los Angeles. His work has been shown at the Shanghai Biennale, ZeroOne/ISEA Festival (San Jose, California), L.A. Louver (Los Angeles), Witte de With, Centre for Contemporary Art (Rotterdam), Ars Electronica Center (Linz), the OK Center for Contemporary Art (Linz), and Socrates Sculpture Park (New York). He is the recipient of an Art Matters grant, Ars Electronica's Prix Ars Award of Distinction, and The Arctic Circle 2009 Residency. Articles about his work have appeared in *Artforum*, *Artweek*, *Art Review*, *I.D.*, the *Los Angeles Times*, the *Wall Street Journal*, and *Artnet*. He is currently an assistant professor in the School of Art & Design at the University of Michigan.

**Daniel Sauter**
Daniel Sauter is an artist who creates interactive installations and site-specific interventions dealing with the cultural and social implications of emergent technologies. His research is driven by a curiosity about how technologies shape and transform urban spaces, social relationships, and the human body. He uses technology as artistic material, embedded in larger social and cultural contexts. His works have been exhibited internationally, in Europe, Asia, and the United States. His current research and writing focus on sensor-based mobile interfaces. In 2010, he founded Chicago's Mobile Processing conference. He received an MFA from the Department of Design | Media Arts, University of California, Los Angeles, and a diploma from the Karlsruhe University of Arts and Design at the ZKM in 2002. He is an associate professor of new media arts and Interim Associate Director at the University of Illinois at Chicago School of Art and Design.

**Basak Senova**
Basak Senova is a curator and designer based in Istanbul. She studied literature and graphic design (MFA in graphic design and PhD in art, design, and architecture at Bilkent University) and attended the 7th Curatorial Training Programme of Stichting De Appel, Amsterdam. She has been writing on art, technology, and media, initiating and developing projects and curating exhibitions since 1995. She is the editor of art-ist 6, Kontrol, Lapses Book Series, UNCOVERED and various other books. She is one of the founding members of NOMAD, as well as the organizer of ctrl_alt_del and Upgrade!Istanbul. She was the curator of the Pavilion of Turkey at the 53rd Venice Biennale (2009). She has lectured at the Faculty of Communication, Kadir Has University, Istanbul (2006-2010). Currently, she co-curates the UNCOVERED project in Cyprus and works as a curator of the Zorlu Center Collection.

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# In Search of the Miraculous

# Introduction

Osman Khan

Wonderment. Mystery. Awe. Einstein believed these to spark the inspiration of both the arts and sciences. Explored within a conference where terms like Art, Science, and Technology are seemingly interchangeable, this would seem a natural place for an exhibition inspired by the same. Indeed one can trace the history of the museum (both Art and Science) to the 16th century Wunderkammer ("wonder-room"), literal Cabinets (and Rooms) of Curiosity, filled with wondrous and exotic objects from the then still unknown world (combining specimens, diagrams, and illustrations from many disciplines; marking the intersection of science and superstition; and drawing on natural, manmade, and artificial worlds). Ironically, these collections, means by which the unknown was empirically and symbolically conquered, also emancipated these superstitious unknowns of their mysterious auras and solidified them to description. And so it moves, Galileo ungods the cosmos and the world learns to spin to logic and reason. So much so that by the late 18th century the Romantic Movement arose in reaction to the Enlightenment's scientific rationalization of nature and society, preferring the viscerality of strong emotions (of horror, terror, awe and wonderment) as the only way to have an authentic aesthetic experience. And so this dichotomy is still at hand, empirical rationality now entwined with capitalism's logic define and optimizes our world, leaving in its wake an alienated society longing to feel something more.

The title of the exhibition, "In Search of the Miraculous," comes from the final work of the artist Bas Jan Ader (an earnest yet fateful performance that saw the artist lost at sea while attempting a solo journey across the Atlantic Ocean), and shares with it a certain romantic sensibility of both hope and melancholy, of the individual (at once both heroic and tragic) within the universal. It is perhaps strange to title an exhibition with this charge when preceded by a century arguably full of more miracles than humankind has ever encountered, albeit through the innovations of none other than ourselves. But perhaps it is due to such trajectories, in a world shrunk by mediating technologies and copious amounts of data, that one is left thinking, What happens when everything is explained away? In a world of Wikipedias and Wikileaks, of mediated social networks greater than nations and geographies, what remains of that authentic experience? When YouTube bit spectacles and mediated warfare debacles color our experiences, can anything still be held in wonder? Perhaps we are at a particular precipice at this time (modernity, postmodernity, capitalism, communism, democracies, revolutions, oh how you have all let us down), the way things are cannot proceed lest we truly destroy it all. Thus, before we burst forth again with 2.0 solutions for it all, perhaps a repose is required, a momentary prick if you will, to escape the doldrums of the everyday and repower the imagination.

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The call for submissions was purposefully ambiguous and unspecific, based not on any particular thematic premise but rather on sentiment; simply an open call for works that both inspire or are inspired by moments of awe, surprise, mystery and wonder. The works selected for the Art Gallery by the 2012 jury are simply a reflection of the emergent aesthetic zeitgeist, a collection of 12 artworks each in their own manner reflecting on the wondrous. Interestingly in a ubiquitously digital world, many of the works move towards the physical and analog. Not a turn towards ludditery (many projects are quite technically complex) but perhaps a reflection of a pervasive ennui for the digital. Certain themes also emerge; nostalgia, for places been or places imagined, for the aura of the pre-cinematic now lost to mass media; reflections on time, stilled for infinity or moved by heartbeats; relationships, of the real and virtual, or imaged as moments between; and of the laboratory, turned inside out, revealing itself as aesthetic matter. But as one reflects on this 21st century Wunderkammer, what echoes most profoundly is that the miraculous is no longer to be found out there but is simply the reflections from within. Call me a heretic but Galileo was wrong – *we* are the center of the universe.

Osman Khan
UNIVERSITY OF MICHIGAN

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# Julian Abraham

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## *Kapitän Biopunk: Fermentation Madness*

*Kapitän Biopunk: Fermentation Madness.* © 2012 Julian Abraham. Photo © 2012 Selina Anna Shah.

*Kapitän Biopunk: Fermentation Madness* is an artistic research project manifested via a series of workshops and an acoustic and performative installation. The artist developed the project in response to the high number of poisonings and deaths of alcohol consumers after an increased excise tax was placed on alcoholic products in Indonesia. The project, using do-it-yourself and open-source technologies, strives to educate individuals on fermentation processes to produce safe and affordable alcoholic products, and a means to democratize the laboratory and liberate knowledge for a wider society.


© 2012 Julian Abraham

In the installation, fermenting tanks filled with exotic fruit juice and yeast cultures are mediated with audio microphones. The audio draws attention to the fermentation process, permitting the audience to listen to the sound of fermentation, as yeast transforms sugar into ethanol and $CO_2$. The sounds generated change in relation to various factors: temperature, sugar level, types of fruit, quantity of yeast, light intensity, and container volume.

Julian Abraham is a media artist, musician, programmer, amateur scientist, and social researcher. Words like manipulating, decomposing, degenerating, and dematerializing are often used to describe his work. Connecting one thing to another, expressed in complex algorithms, helped him understand how art, the environment, science, and technology relate to one another – providing new tools to educate and engage both himself and society into a wiser, richer, and more independent existence in a world of creation and annihilation. From 2006 until 2011, Abraham dedicated his life to The House of Natural Fiber, a media artist collective based in Yogyakarta, Indonesia. He has produced and organized numerous festivals, workshops, exhibitions, performances, and concerts.

# Philipp Artus

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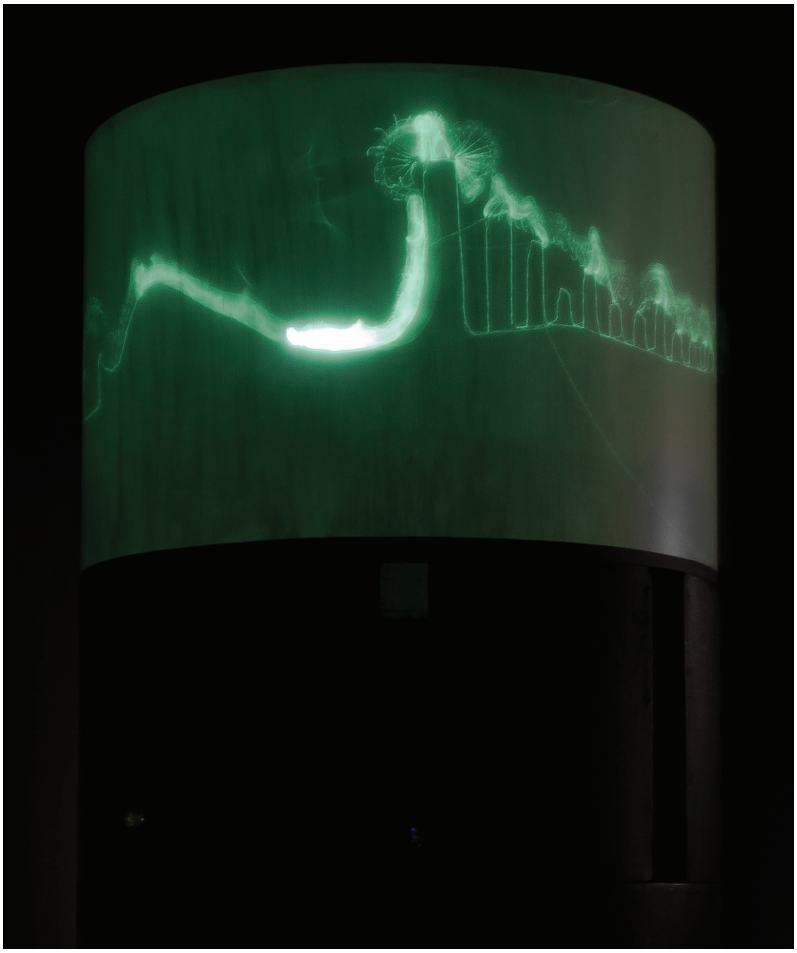
## *snail trail*



*snail trail*. © 2011 Philipp Artus.

Philipp Artus' *snail trail* is a 360-degree laser animation loop projected onto a column. The two-minute animation relates the story of a snail which, in response to its environment, keeps evolving new means of locomotion, ultimately inventing the wheel and eventually devolving back to its original form. The projection surface is made from a phosphorescent material creating an afterglow that slowly fades out. As a result of the phosphorescent trails, viewers can simultaneously see what happens, what has happened, and what will happen. This reflection on time is elaborated further through the endlessly cycling structure of the work as well as through the recurring pulse of sound and light, which refers to periodic natural phenomena like the tides or the seasons.

The concept for the animation stems from Artus' reflections on the processes of exponential evolutionary acceleration in different periodic ages, Darwin's theory of evolution, and the manner in which environment influences our own communication and behavior.

*snail trail* is accompanied with music by Madalena Graça.

Philipp Artus' experimental animations and site-specific installations explore the manifestations of life through movement, sound, and imagery. He composes audio/visual experiences that unite playful elements with minimalist structures, timeless themes with contemporary observations, turbulent acceleration with contemplative silence.

Philipp Artus was born in Bremen, Germany and began studying art at the École des Beaux Arts in Nantes (France). He continued his autodidactic studies of animation and music theory in Portugal and is currently finishing his graduation project at the Kunsthochschule für Medien Köln (Germany). Artus' work has been shown in various museums, festivals, and galleries around the world, including the Museum of Contemporary Art Kanazawa (Japan), the European Media Art Festival (Germany), Athens Video Art Festival (Greece), Videoformes (France), LUMINALE (Germany), and the DOTMOV Festival (Japan).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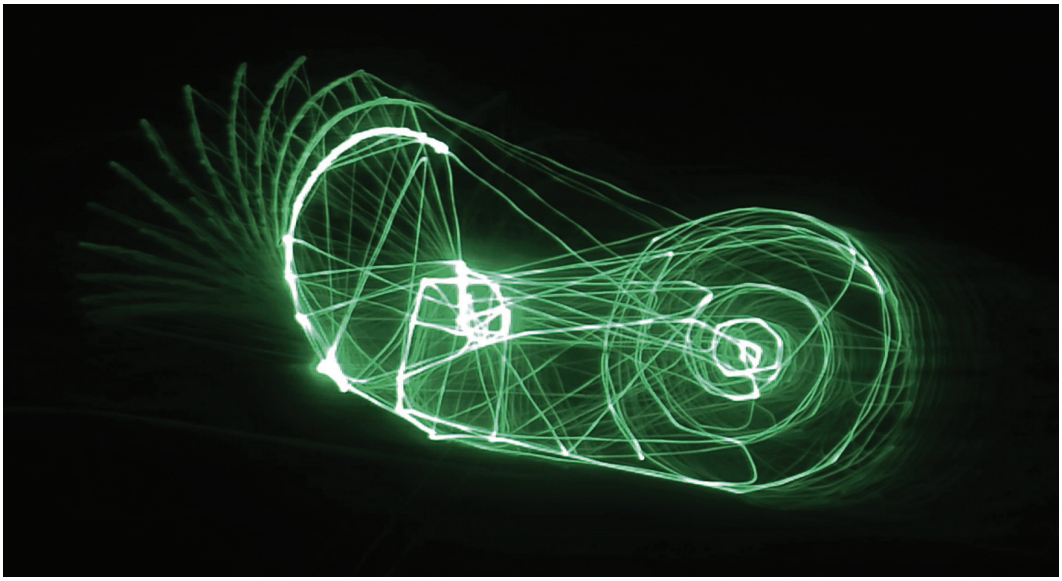
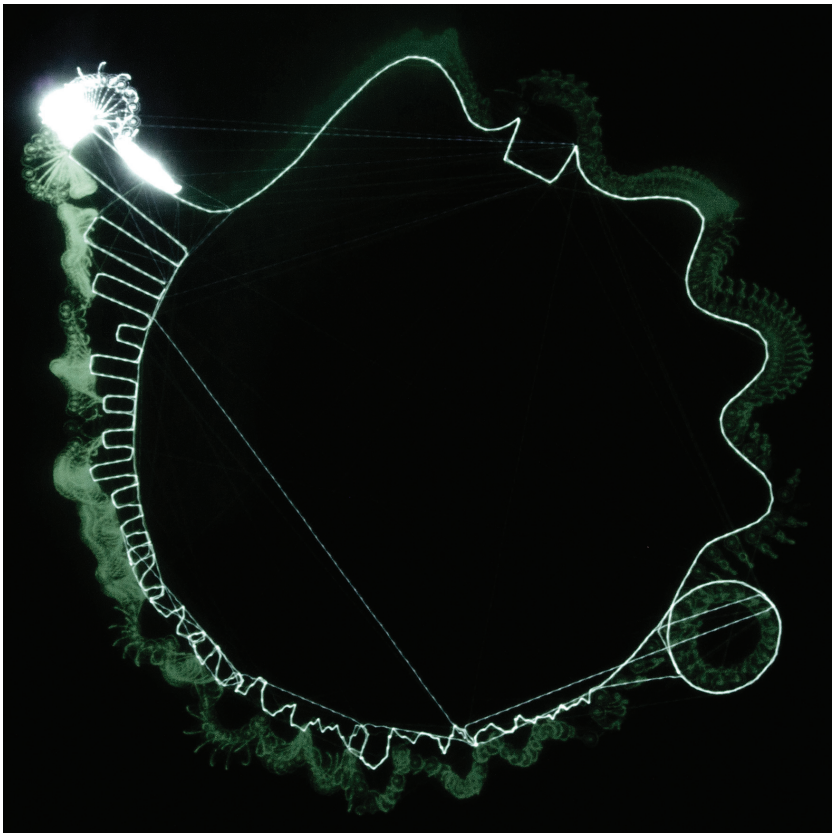


*snail trail*. © 2011 Philipp Artus.



*snail trail*. © 2011 Philipp Artus.

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## *Saturation*

*Saturation.* © 2011 Adam Laskowitz and Daniel Barry.

*Saturation* is an installation that highlights the abundance of wireless signals occupying the electromagnetic spectrum. The work indexes the FM radio spectrum to reveal the density of the invisible communications infrastructure saturating the environment and our bodies.

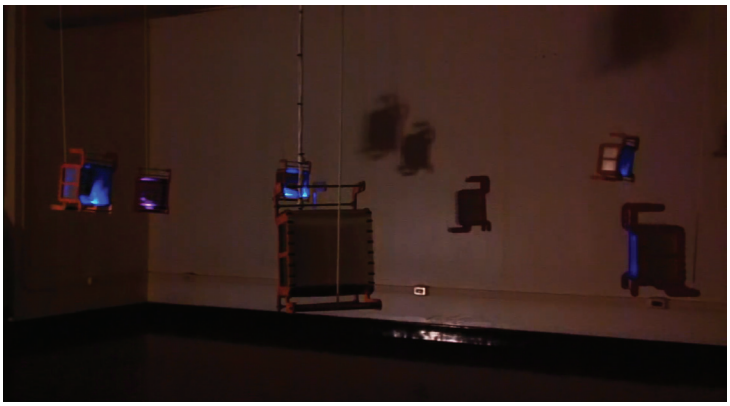
The work is installed in the form of an enormous chandelier; a set of open aluminum boxes housing FM radios are strung together and hung from the center of the ceiling. At rest, while concealed within their enclosures, the radio receivers output an ocean of static. Once exposed, the radios each connect to a different station, filling the space with a cacophony of noise. This process reveals a densely populated, dynamic array of electromagnetic fields that, while intangible, constantly permeate our bodies and environment.

The aluminum enclosures act as Faraday Cages, preventing the radios from receiving a signal. Each enclosure's aggregation and directionality is determined through the installation's spatial orientation to the source of the broadcast, disrupting the signal's reception, and creating a field of static noise. Because the body absorbs electromagnetic signals, the radios may connect to the signal when a human hand is within close proximity of the radio inside the enclosure. This engagement with the installation exposes a realization of the effects that bodies and wireless signals impose upon one another. While this experience remains confined to a single broadcast, the multitude of signals can be experienced through simultaneously releasing each of the radios with a single pulley actuation. This releases an eruption of sounds, which exposes the dense saturation of the environment and reveals the wonderment of experiencing the multiplicity of signal presence at any given moment.

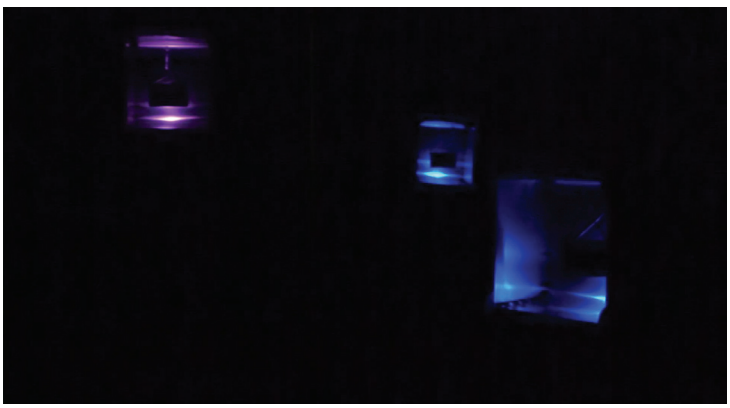

© 2012 Daniel Barry and Adam Laskowitz

Daniel Barry is a member of the media . architecture . computing program at the University at Buffalo (USA). In 2009, he graduated from the University at Buffalo with a bachelor of science in architecture and continued at the University at Buffalo in the Department of Architecture and the Department of Media Study to pursue both a master of architecture and a master of fine arts. His research interests are focused on mobile computing technologies and how they negotiate social and spatial relationships. His work indexes mobile devices as prosthetic extensions of the body and their modification to extend our cognition of the complex invisible architectures of contemporary urban environments. His work has been internationally recognized through exhibitions and publications in France, Japan, and the United States. As the Fred Wallace Brunkow Fellow, he is the designer and editor of *Intersight*, the University at Buffalo School of Architecture and Planning's annual journal of student work.

Adam Laskowitz is an artist, designer, and musician. He is currently a member of the media . architecture . computing program at the University at Buffalo (USA), pursuing a master of architecture and master of fine arts. He received a bachelor of science in architecture from the University at Buffalo in 2009. His current research focuses on the ways in which digital technologies can make mundane, everyday interactions with space surprising, entertaining, and exciting through a particular lens of sound production and consumption. His work deals with the interactions among people, places, and the objects that occupy space, focusing on the social and spatial implications of computing technologies. His work has been exhibited and published in Germany, France, Japan, and the United States. In the summer of 2012, he joined the Intel research labs in Portland, Oregon, where he is focusing on sensor networks and how complex datasets can be visualized for use by the public.



*Saturation.* © 2011 Adam Laskowitz and Daniel Barry.



*Saturation.* © 2011 Adam Laskowitz and Daniel Barry.

# Alejandro Borsani

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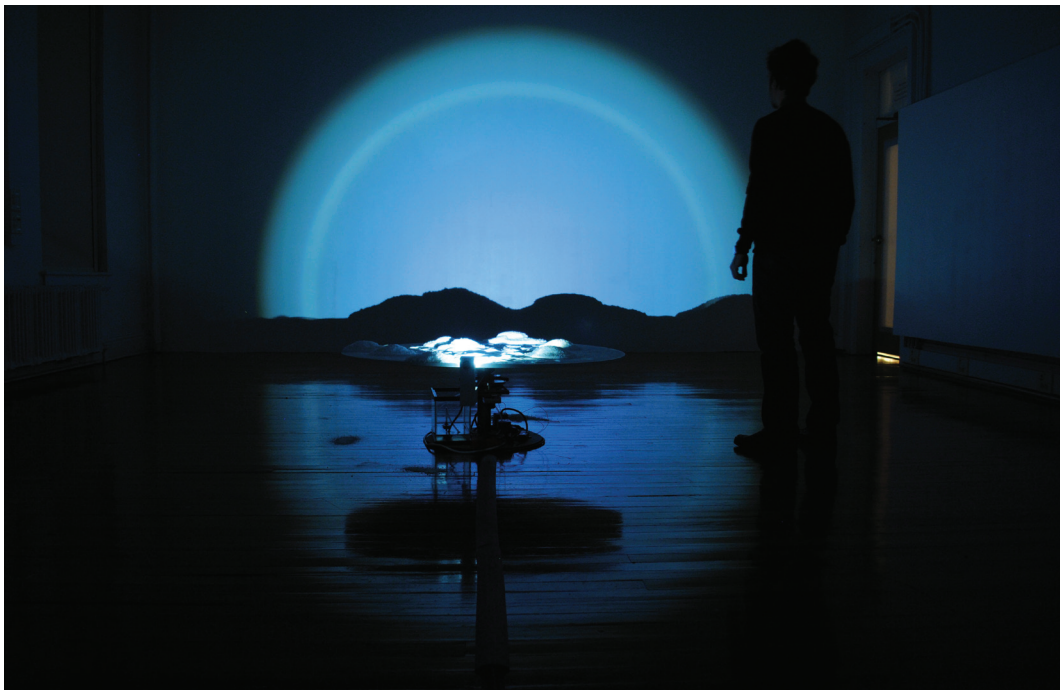
## *90° South*

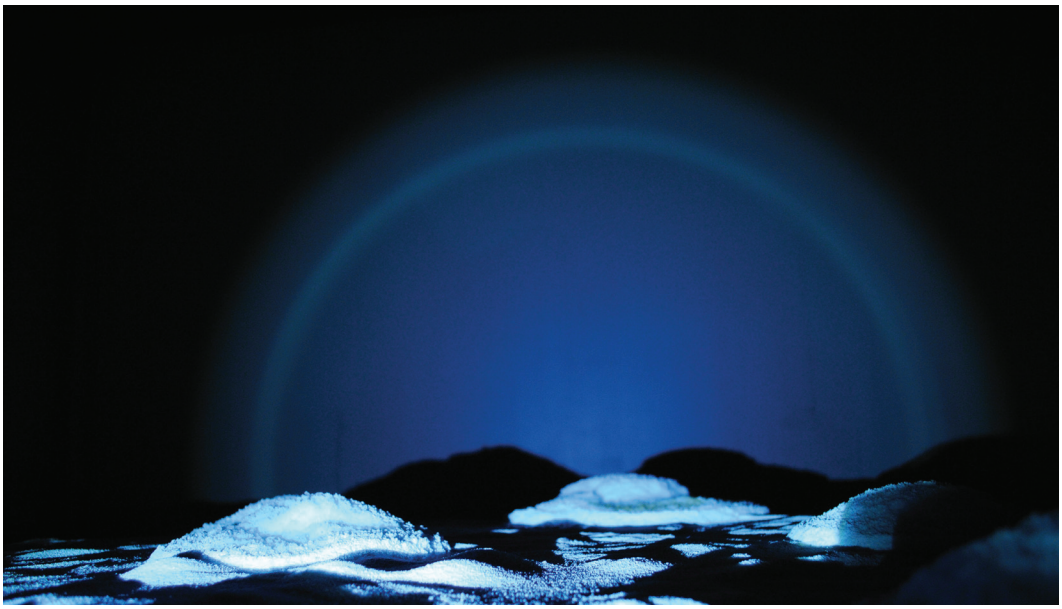


*90° South*. © 2010 Alejandro Borsani.

Alejandro Borsani's *90° South* provides a contemplative point of view that allows the viewer to witness and be immersed in the constant evolution of a growing landscape. The work utilizes an irrigation system in conjunction with a highly absorbent material (sodium polyacrylate) to produce a slowly emerging landscape. A thin layer of the white material is placed on top of a round surface. When water reaches the surface, the sodium polyacrylate expands 300 times, producing subtle undulations. The profiles of these miniature mountains are projected onto the walls of the gallery using a flashlight attached to a rotating mechanism.

In *90° South*, Borsani attempts to create the experience of a constantly changing landscape by building a system with an unpredictable emergent topography. For Borsani, "all the knowledge of the world is gained from our own particular points of view, or from some experience of the world without which the symbols of science would be meaningless. In order to find new possibilities, we must begin by reawakening the basic experience of the world of which words are the second-order expression. Wonderment is critical, since it allows for continued curiosity to this basic experience and thus creates the possibility for change."


© 2012 Alejandro Borsani 



*90° South*. © 2010 Alejandro Borsani.

Borsani's work is an active exploration of the nature of perception and media representation in the form of sculptures, installations, and environments. With non-spectacular technologies he creates ambiguous moments between the event and the effect so the viewer may experience an instant where rational reflection, bodily experimentation, and emotional contemplation become indivisible. He is fascinated by the idea of using physical phenomena as the main materials for his installations. Borsani's most recent work uses gravity, heat, cold, and chemical reactions to investigate how human beings deal with the inorganic, wordless nature of their environments.

Alejandro Borsani is currently pursuing an MFA at the Rensselaer Polytechnic Institute (USA). He received an MFA in electronic visualization from the School of Art and Design of the University of Illinois at Chicago in 2010 and a BA in audio/visual design from the School of Architecture, Design and Urbanism of the University of Buenos Aires (Argentina) in 2007. His work has been shown in several international venues, including the Museum of Modern Art of Buenos Aires (Argentina), the Metropolitan Art Preview Buenos Aires-Berlin, Centro Hipermediático Experimental Latinoamericano (Argentina), Collections and Archives of Mess Hall (USA), Gallery 400 (USA), Centro Cultural Borges (Argentina), and Albany Underground Artists – Athletic Annex Exhibition (USA).

# Rémi Brun

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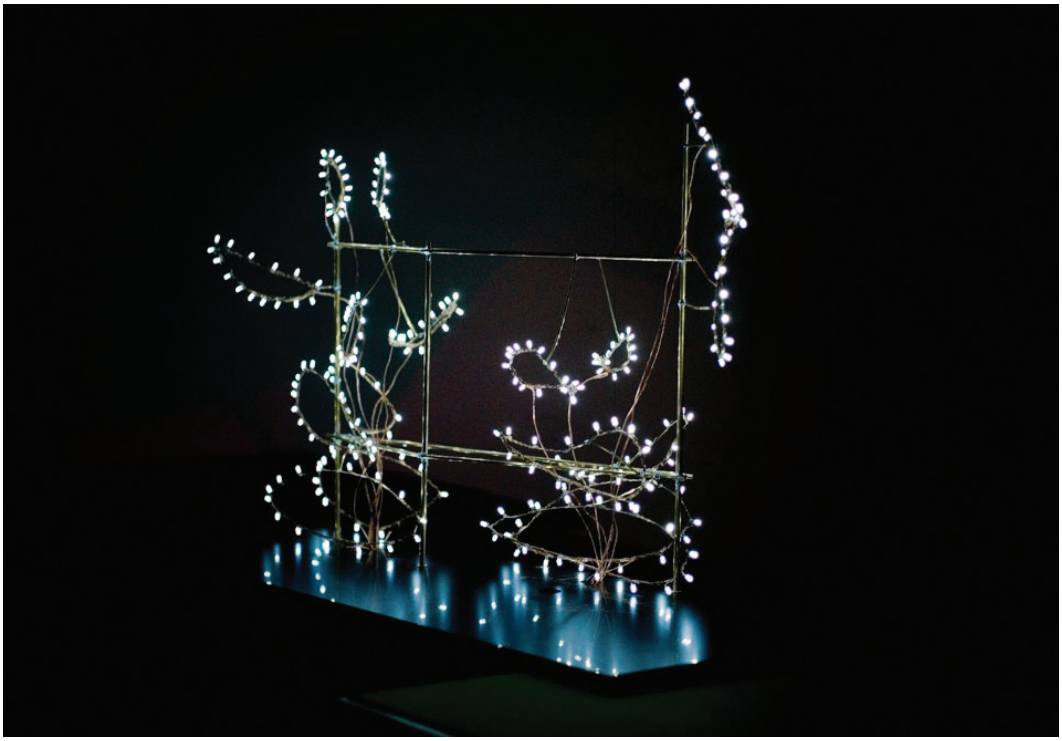
## *The Galloping Horse*

*The Galloping Horse.*
© 2012 Rémi Brun. Photo © 2011 Stéphanie Sidhu-Brun.

*The Galloping Horse* is created using 18 bright diodes that trace their trajectories through a system of steel bars, LEDs, and cables that coincide to create the illusion of a moving image of a life-size galloping horse. The work pays homage to the work of Etienne-Jules Marey and Eadweard Muybridge, both pioneers at the frontier of art, science, cinema, and biomechanics, who were interested in the movement created by galloping horses. Beyond the gallop of the horse, Brun's animated sculpture asks viewers to question their own movements, sparking a sense of curiosity and wonderment.

Rémi Brun holds a PhD in biomechanics and has been working for over 18 years in the field of motion capture (mocap) for video games, cinema, dance, and scientific research. He was the mocap specialist behind the virtual actress Eve Solal (SIGGRAPH 2000/2001) and the feature film "Renaissance" (the first mocap movie in Europe), as well as many other projects. Through his own company, MocapLab, he continues to push the boundaries of motion capture. As an artist, he has come to see movement as a material of its own, independent from the matter that comes with it. In his recent projects involving dance, sports, and everyday movements, he searches for ways to extract movement from the body matter and to confront it with new appearances.



*The Galloping Horse.* © 2012 Rémi Brun. Photo © 2008 Hugo Ramirez.

# Martin John Callanan

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## *A Planetary Order (Terrestrial Cloud Globe)*

*A Planetary Order (Terrestrial Cloud Globe)*. © 2012 Martin John Callanan.

*A Planetary Order* is a terrestrial globe depicting clouds from a single moment in time. The globe itself is a physical visualization of real-time scientific data. To create the work, Callanan took one second of readings from all six cloud-monitoring satellites currently overseen by NASA and the European Space Agency and transformed the information physically into outlines and profiles of the clouds that were emerging at that moment across the surface of the Earth. The shimmering white cloud globe freeze-frames the entire operation of the global atmospheric regime and highlights the fragility of the environmental (and informational) systems that operate across the world.

*A Planetary Order (Terrestrial Cloud Globe).* © 2012 Martin John Callanan.

Martin John Callanan is an artist whose work spans numerous media and engages both emerging and commonplace technology. His work has included translating active communication data into music; freezing in time the earth's water system; writing thousands of letters; capturing newspapers from around the world as they are published; taming wind onto the internet; and broadcasting his precise physical location live for over two years. Callanan's work has been exhibited, published and screened at venues throughout Europe, Russia, North America, South America, Asia and Australia. He obtained degrees from both the Birmingham Institute of Art and Design (UK) and University College London (UK). Callanan is currently a Teaching Fellow in Fine Art Media (Digital Media & Print) at the Slade School of Fine Art, University College London (UK).

*A Planetary Order (Terrestrial Cloud Globe).* © 2012 Martin John Callanan.

# Carlos Castellanos and Steven J. Barnes

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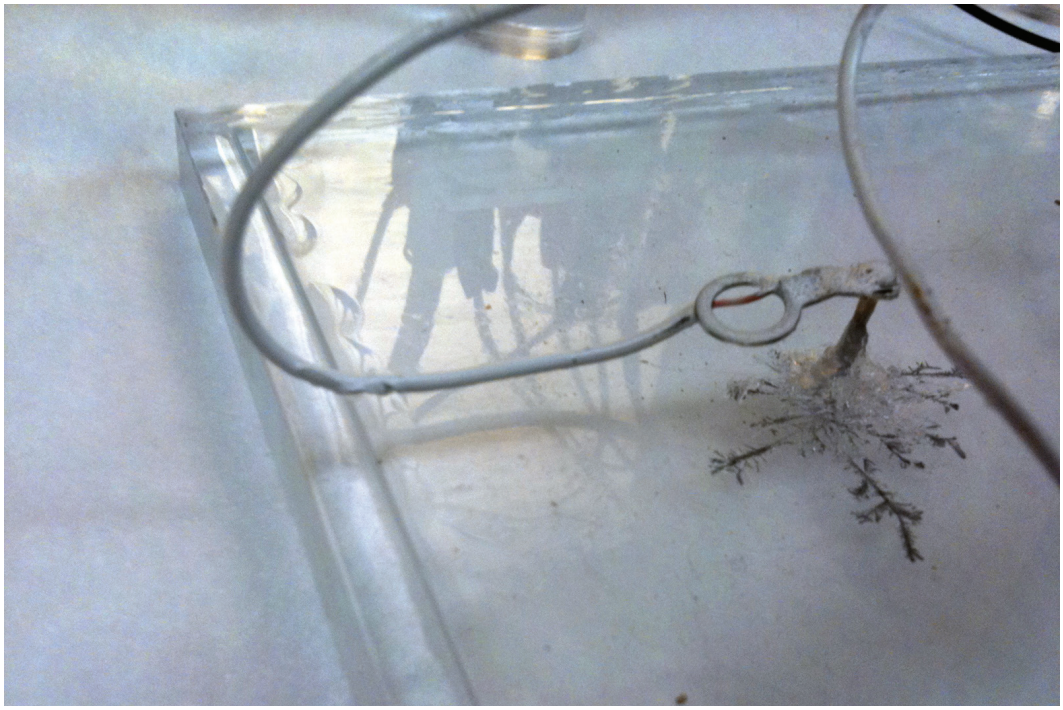
## *Biopoiesis*

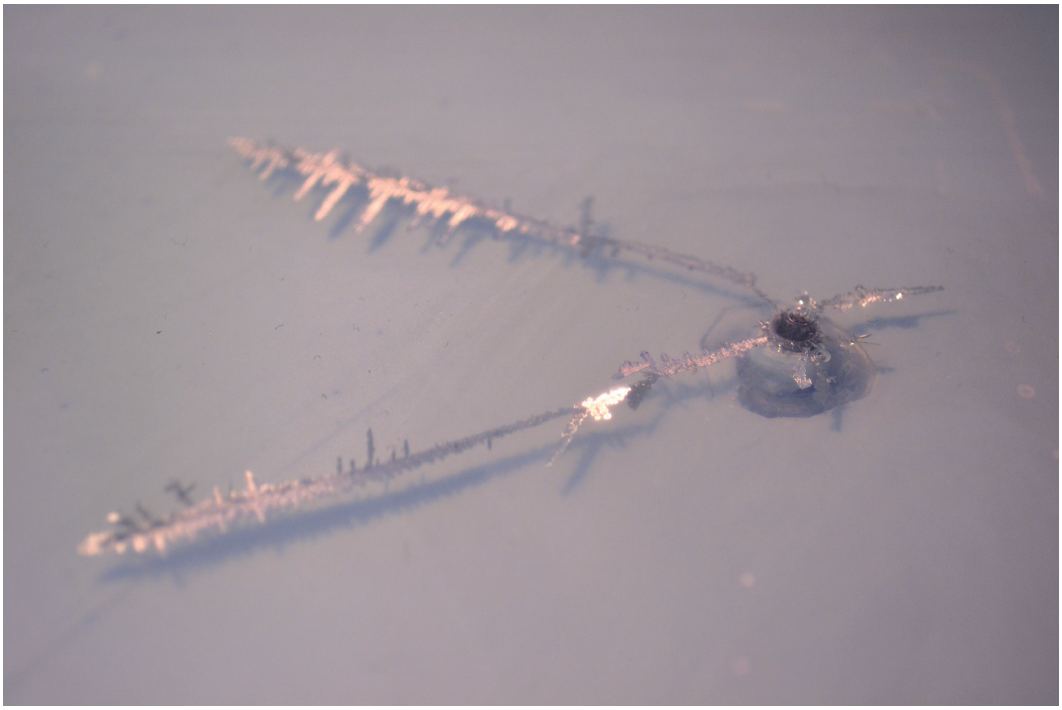


*Biopoiesis*. © 2011-2012 DPrime Research.

*Biopoiesis* is a series of experiments exploring the relationships between structure, matter, and self-organization. The project features the construction of analog computation and control systems that harness electrochemical reactions and form what can be described as a computational "primordial soup." Information (an electrical signal) is passed through electrodes to a tank filled with a metallic salt solution (e.g. stannous chloride). The resultant electrochemical reaction grows into dendritic metallic threads – ultimately leading to the formation of a continuously shifting signal network that can be used to develop a complex, self-organizing media system.

Carlos Castellanos is an interdisciplinary artist and researcher with interests in embodiment as it relates to systems theory, artificial intelligence, and artificial life. He is exploring the aesthetics of information technologies and their effects on lived, embodied human experience. This has taken a variety of forms, including scholarly writing, net art, interactive installation, sound, performance, and techno-conceptual systems. He is currently pursuing a PhD at the School of Interactive Arts and Technology, Simon Fraser University (Canada), and splits his time between Vancouver and San Francisco.


© 2012 Carlos Castellanos and Steven J. Barnes



*Biopoiesis*. © 2011-2012 DPrime Research.

Steven J. Barnes holds a PhD from the University of British Columbia (Canada). Trained as a behavioral neuroscientist, his neuroscientific expertise lies in the areas of learning and memory, psychiatric disorders, epilepsy, neuroplasticity, and metaplasticity. He currently teaches neuroscience and psychology at UBC; does research in the areas of (non-traditional) virtual reality, bodily awareness, and embodied cognition; and runs a consulting and programming business.

*Biopoiesis* was developed by Carlos Castellanos and Steven J. Barnes of DPrime Research.

# Scott Hessels

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## *Sustainable Cinema No. 4: Shadow Play*

*Sustainable Cinema No. 4: Shadow Play.*
© 2011 Scott Hessels.

The wind-powered *Sustainable Cinema No. 4: Shadow Play* is a kinetic public sculpture that harnesses sustainable energy to generate a moving image. By using natural power to re-create an early art form that led to the beginnings of cinema, the sculpture references the histories of both motion pictures and industrialization. It explores a possible future of environmentally responsible media; looking forward by looking back.

The *Sustainable Cinema* is a series of artworks that considers alternative systems to create a moving image (as if cinema had continued to evolve with sustainable elements instead of being co-opted by the industrial and digital ages). Despite the spreading audiovisuality of culture, and finding oneself surrounded by screens, there is rarely an understanding of the technology behind them. The sculptures in this series attempt to offer moments where the mystery of the moving image can be grasped. They are simple illusions created with simple energy that ask viewers to reflect on the original magic of film. It is a primal media experience, which, due to the rapid development of cinema technologies, is no longer an oxymoron.

Scott Hessels is a filmmaker, sculptor, and media artist who explores new relationships between the moving image and the environment. His artworks span several media, including film, video, the web, music, broadcast, print, kinetic sculpture, and performance. His films have been shown in numerous international film festivals, and his new media installations have been presented in exhibitions around the world, included in books on new media art and in publications such as *Wired* and *Discover*. His recent projects have mixed film with sensors, robotics, GPS systems, and alternative forms of interactivity, and have included partnerships with NASA, Federal Aviation Administration, and Nokia, among others. He is currently an associate professor at the School of Creative Media at the City University of Hong Kong (China).


© 2012 Scott Hessels 

*Sustainable Cinema No. 4: Shadow Play.*
© 2011 Scott Hessels.

# Julie Legault

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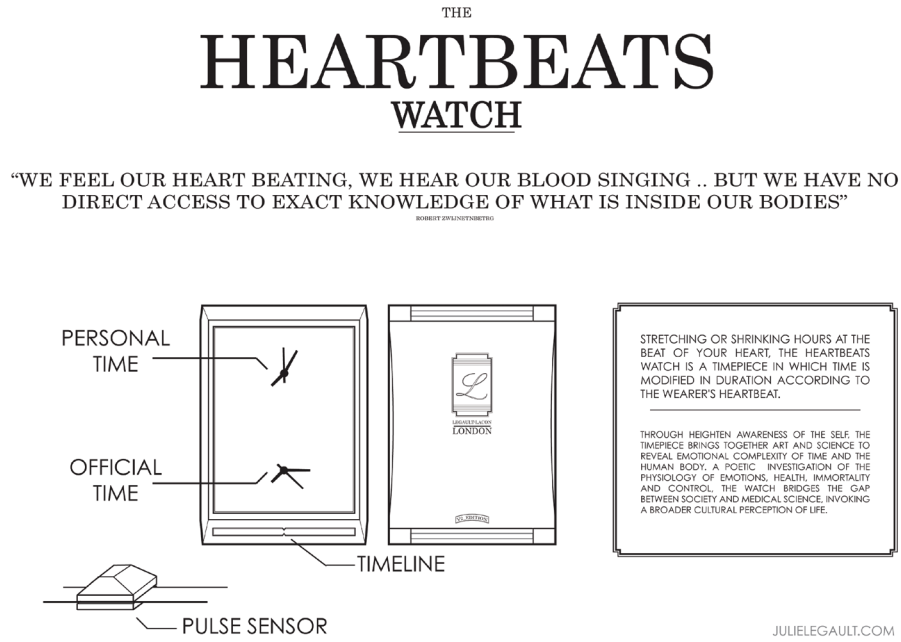
## *The HeartBeats Watch*

*The HeartBeats Watch*.
© 2011 Julie Legault.

Stretching or shrinking hours at the beat of your heart, *The HeartBeats Watch* is a timepiece in which the duration of time is paced not by seconds but according to the wearer's heartbeat. Through a heightened awareness of self, *The HeartsBeats Watch* brings together art and science to reveal emotional complexity of time and the human body. A poetic investigation of the physiology of emotions, health, immortality and control, the watch bridges the gap between society and medical science, invoking a broader cultural perception of life.

Through the premise of accessories and jewelry as providers of "superpowers" and the idea of objects of comfort, Julie Legault explores the possible futures of accessories through technology, function, and fantasy, using the premise of technology as magic to combine materials and circuitry, creating wearable wonders. Her current research concerns the relationships that mentally and emotionally disabled individuals have with objects and accessories. Working from the outside in, she hopes not only to understand and improve these relationships and their impact on the individual's social presence, but also to distill the essence of these relationships to benefit a wider audience, adding some missing magic along the way. To avoid the impending "under the skin" aspect of hybridization, Legault's work also explores the ethics and obsolescence of consumer culture by providing insights and tools for self-awareness and wonder.


© 2012 Julie Legault 




*The HeartBeats Watch*.
© 2011 Julie Legault.

*The HeartBeats Watch*. © 2011 Julie Legault. Photo © 2011 V2_Institute of the Unstable Media.

Julie Legault is an interdisciplinary designer. She was born in Montréal, Canada, and lives and works in London, UK. She received her BA from Concordia University (Canada) where she studied design, art, and digital technologies. In 2011, she received an MA in Goldsmithing, Silversmithing, Metalwork, and Jewelry at the Royal College of Art, London (UK). Having worked with Moritz Waldemeyer, Joanna Berzowska, and the V2_Unstable Media Lab in Rotterdam, she recently presented her work on wearable wonders (the results of her ongoing research in the hybridization of humans and machines) in Europe and North America, notably at the Victoria & Albert Museum (UK), ISEA 2011 (Turkey), and TEI 2012 (Canada).

# Kärt Ojavee and Eszter Ozsvald

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## *SymbiosisS*

*SymbiosisS*. © 2011 Kärt Ojavee and Eszter Ozsvald. Photo © 2011 Eszter Ozsvald.

*SymbiosisS* is part of a collection of textile interfaces, *SymbiosisO* ("O" for objects), which behave as organic displays and react to definable impulses by showing pre-defined patterns that animate slowly over the surface. It welcomes viewers to sit and rest on soft-folded material that displays an active, slowly shifting pattern. When excited, the pattern starts forming, in a playful, curious way, around the place where the textile was touched. Once the disturbance is abated, the pattern continues its peaceful expansion. This vivacious interaction of a vibrant pattern is a demonstration of the potential for tangible textile interfaces. Ubiquitous computation – an active, programmable secondary skin to surround everyday objects – is an ambient, "noiseless," and thus vigorous way to visualize information and form space.

Production of *SymbiosisS* involves both handicraft and specialized digital fabrication. Electronics that activate a heat-sensitive coating layer are embedded in the soft structure. The substrate is felt, which has exceptional material properties (sound isolation, heat preservation, biodegradable, etc.). The geometry of the patterns is derived from Voronoi tessellation algorithms, which, in this case, intuitively suggest folding the material into a three-dimensional landscape. The general concept of the work is a tribute to the ultimate power of evolution, where not only human civilization affects the environment, but nature itself also reacts and adapts to these changes. Instead of criticizing civilization's impact on the environment, the emphasis focuses on exploration of new types of mutant living beings.


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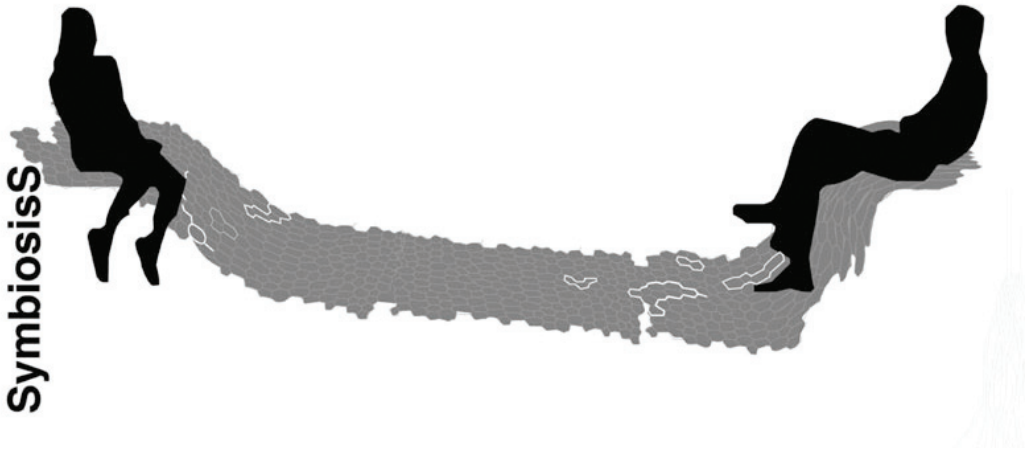
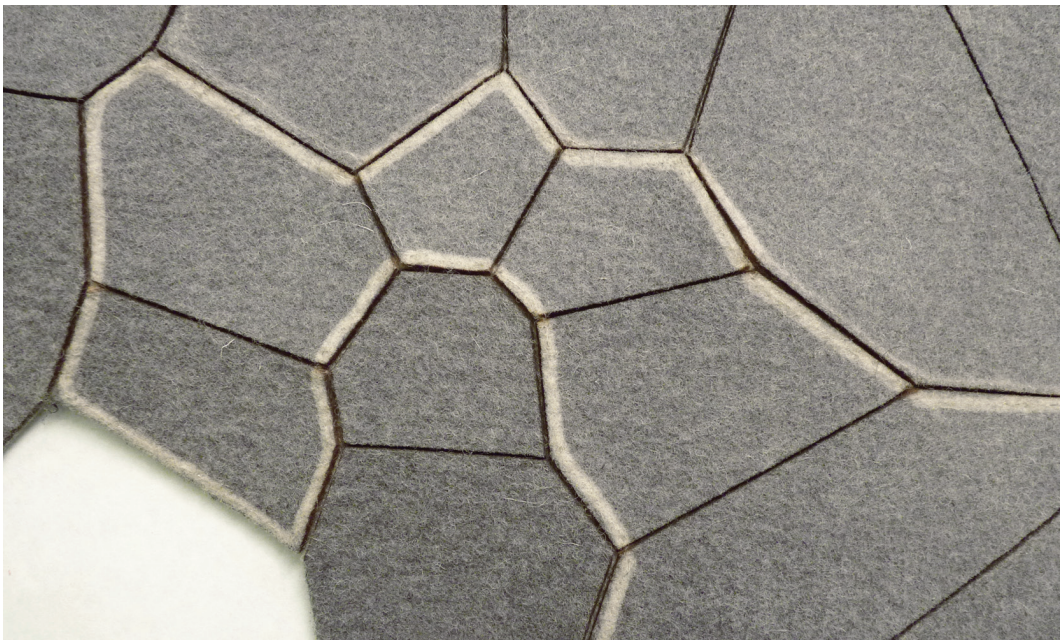



*SymbiosisS*. © 2011 Kärt Ojavee and Eszter Ozsvald. Figure © 2011 Kärt Ojavee.



*SymbiosisS*. © 2011 Kärt Ojavee and Eszter Ozsvald. Photo © 2011 Eszter Ozsvald.

Kärt Ojavee is an Estonian designer and researcher who has been working on active and interactive textiles since 2004. Currently, she is working with the Centre for Biorobotics (Estonia) to create interactive textiles for waiting rooms. The focus in her textile designs is on patterns and new approaches to materials.

Eszter Ozsvald is a Hungarian designer, technologist, and media artist based in New York. Currently, she is enrolled in New York University's Interactive Telecommunications Program (USA), where she continues to seek creative interdisciplinary applications with a technological edge.

# Kian-Peng Ong

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## *Coronado*

*Coronado.* © 2012 Kian-Peng Ong.

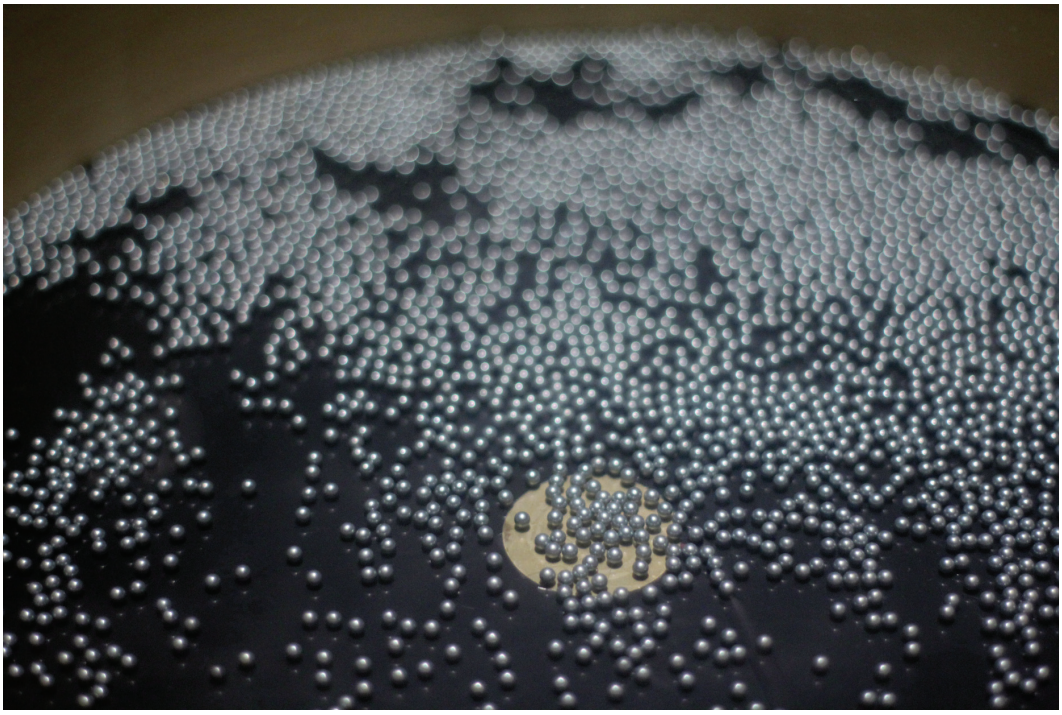
*Coronado* is a six-channel sound installation in which an ocean drum is controlled by autonomous mechanical arms, creating a feedback loop that bounces sound waves and produces a spatial interpretation of the beach's soundscape. A sense of wonder and awe is at the heart of *Coronado*, which was inspired by the artist's personal encounter with the Coronado beach in California, where he found beauty appearing and disappearing in all directions.

Kian-Peng Ong (a.k.a. Bin) works across a range of media that include software, electronics, sound, and video. For the past five years, he has been using new media as a means to question and transcode human perception and understanding of the environment and the problems associated with it. Kian-Peng Ong's works are very often a result of his personal experiences and encounters with the world.

Kian-Peng Ong is a new media artist based in Los Angeles. He received his BA (interactive arts) from Lasalle College of the Arts (Singapore). Currently, he is a graduate student in the UCLA Design | Media Arts program (USA). His interest in sound stems from its abstract yet powerful affective qualities. Of equal interest to him, and a focus of one of his ongoing research projects, is the human relationship with nature, specifically how humans adapt or perceive environmental changes. Technology often plays a central role in his work, creating an experience, harmonizing with the theme and conceptual framework, without focusing the work on the technology itself.


© 2012 Kian-Peng Ong

*Coronado.* © 2012 Kian-Peng Ong.



*Coronado.* © 2012 Kian-Peng Ong.

# SWAMP

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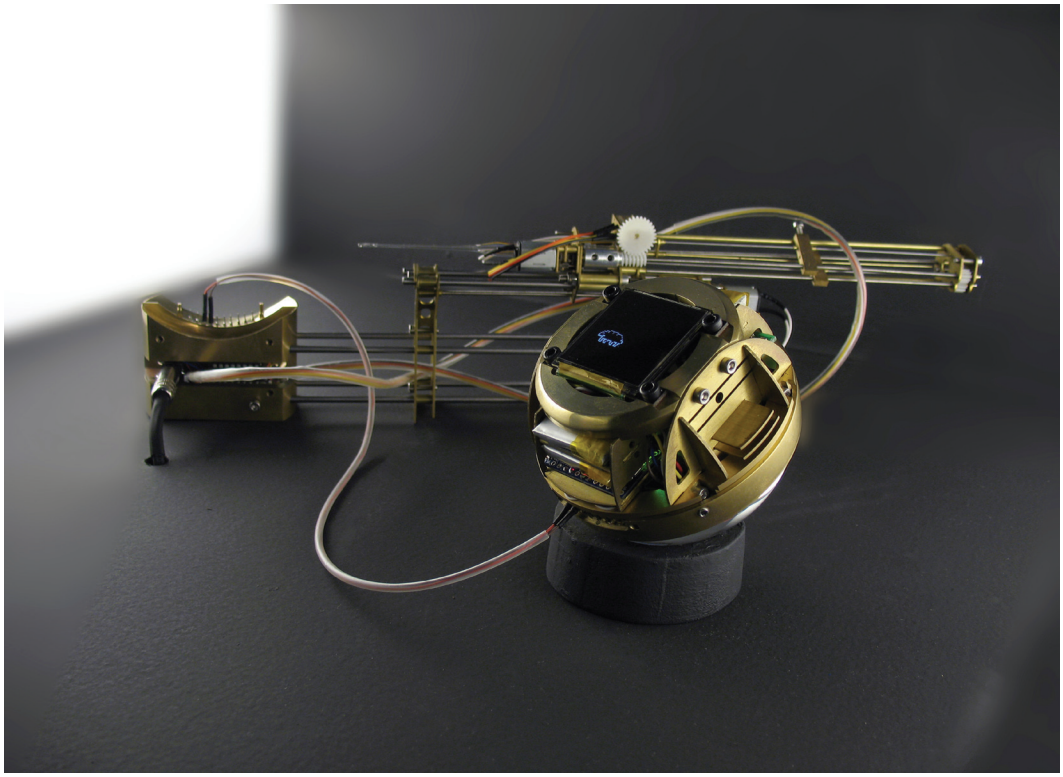
## *Tardigotchi*



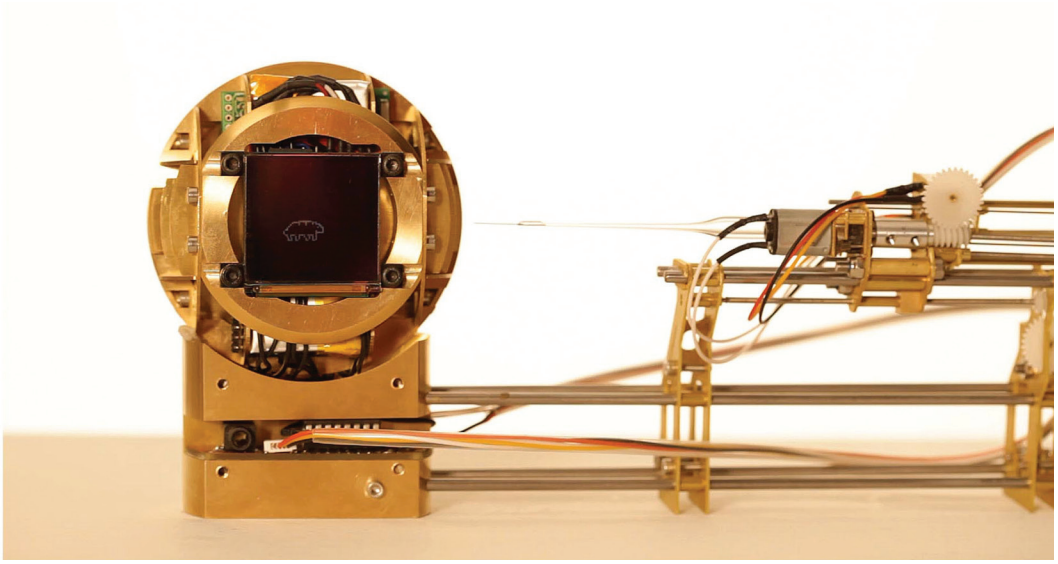
*Tardigotchi*. © 2012 SWAMP.
Photo © 2012 SWAMP + Tiago Rorke.

*Tardigotchi* is an artwork featuring two pets: a living organism and an alife avatar. These two disparate beings find themselves the unlikely denizens of a portable computing enclosure. The main body for this enclosure is a brass sphere, housing the avatar in an LED screen and a tardigrade within a prepared slide. A tardigrade is a common microorganism measuring half a millimeter in length. The avatar is a caricature of this tardigrade; the avatar's behavior is partially autonomous, but it also reflects a considerable amount of expression directly from the tardigrade's activities.

This portable sphere playfully references the famous Tamagotchi toy from the 1990s that provoked the artists to ask questions such as: Does simple interaction engender emotional attachment? Can feelings of affection blossom from the ritual of assisting the persistence of a pattern? Does biological life make a difference?

A *Tardigotchi* owner cares for a real and a virtual creature simultaneously. By pushing a button, the virtual pet is fed, this in turn will feed the tardigrade. An owner may also attend to the *Tardigotchi* online through a social web presence. Sending an email to the virtual character triggers a heating lamp, relaying a momentary signal of warmth to the tardigrade, while

 © 2012 SWAMP | Leonardo, Vol. 45, No. 4, pp. 392–393, 2012



*Tardigotchi*. © 2012 SWAMP.
Photo © 2012 SWAMP + Tiago Rorke.

*Tardigotchi*. © 2012 SWAMP.
Photo © 2012 SWAMP + Tiago Rorke.

prompting the pixilated tardigrade to recline and soak up animated sunrays. *Tardigotchi* applies a salve to our yearnings for care and nurture through a unique design that symbiotically merges biological and artificial life within a single interface/enclosure. It also serves as a reminder of the special inclination humans have to commune with other animals, perhaps equally with artificial ones. Humans, along with the inhabitants of *Tardigotchi*, and every other living being, are neighbors subsisting on an incredibly precarious life-sphere known as Earth.

SWAMP (Studies of Work Atmosphere and Mass Production) is the collaborative effort of artists Matt Kenyon and Douglas Easterly with Tiago Rorke. Their work focuses on critical themes addressing the effects of global corporate operations, mass media and communication, military industrial complexes, and general meditations on the liminal area between life and artificial life. SWAMP has been making work in this vein since 1999, using a wide range of media, including custom software, electronics, mechanical devices, and living organisms.

# Leonardo Network News

The Newsletter of the International Society for the Arts, Sciences and Technology and of l'Observatoire Leonardo des Arts et Technosciences

**Leonardo Network News Coordinator:** Kathleen Quillian
**E-mail:** <kq@leonardo.info>

## LEONARDO AFFILIATE PROGRAM: NEW DIRECTIONS AND BENEFITS

The Leonardo Affiliate Program is a growing community of leading universities, nonprofits and corporations engaged in research and creative activities at the intersection of the arts, sciences and technology. Organizations may now participate in the Leonardo Affiliate Program at the Affiliate or Senior Affiliate levels, which include increased benefits and value. Leonardo Affiliates may propose, plan and implement new Leonardo programs, events and projects; pursue joint funding and collaborative research and creative activities; present the research and creative work of faculty and students in Leonardo publications; and more. Leonardo Affiliates are key partners in shaping the direction of Leonardo/ISAST and the future of Art/Science.

Current Affiliates include Arizona State University Art Museum; CalArts, Herb Alpert School of Music; Danube University at Krems; De Montfort University, Institute for Creative Technologies; Emily Carr University of Art & Design; Plymouth University; Pomona College; School of the Art Institute of Chicago, Sound Department; School of Visual Arts, Computer Art Department; Universidad Autonoma de Occidente, Engineering Department; UCLA Art|Sci Center; University of Caldas, Arts & Humanities; University of Technology, Sydney, Creativity & Cognition Studios; University of Texas at Dallas, Arts and Technology.

We invite organizations to join the Leonardo Affiliate Program as we embark on a new era of participation. <www.leonardo.info/isast/affiliates.html>

## LEONARDO E-BOOKS NOW AVAILABLE FROM THE MIT PRESS

We are pleased to announce that several titles from the Leonardo Book Series are now available as e-books from the MIT Press, Amazon, Google, Kobo and Barnes & Noble. Titles include: *CODE: Collaborative Ownership and the Digital Economy*, by Rishab Aiyer Ghosh; *Global Genome: Biotechnology, Politics, and Culture*, by Eugene Thacker; *Green Light: Toward an Art of Evolution*, by George Gessert; *The Hidden Sense: Synesthesia in Art and Science*, by Cretien van Campen; *The Language of New Media*, by Lev Manovich; *Tactical Biopolitics: Art, Activism and Technoscience*, by Beatriz da Costa and Kavita Philip; and *Vo1CE: Vocal Aesthetics in Digital Arts and Media*, by Norie Neumark, Ross Gibson and Theo van Leeuwen. <www.leonardo.info/isast/announcements/Leonardo-ebooks.html>

## JOURNAL ARTICLES NOW AVAILABLE PRE-PUBLICATION THROUGH EARLY ACCESS SYSTEM

Leonardo is pleased to announce a new early access publication service through MIT Press by which accepted *Leonardo* and *Leonardo Music Journal* articles are made available to subscribers after successful completion of peer review but prior to their publication in print. Leonardo publications are being restructured to be web-centric to accelerate the distribution of reliable peer-reviewed articles. Professionals in the art, science, technology field — both authors and readers — will benefit from this early access program of accepted articles.
<www.mitpressjournals.org/toc/leon/o/o>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## LMJ EDITORIAL BOARD WELCOMES NEW MEMBERS

*Leonardo Music Journal* welcomes four new members to the LMJ Editorial Board: Christoph Cox, Yan Jun, Andrea Polli and Tara Rodgers, who have been enlisted to help bring expertise in emerging areas of sound work, such as Phonography, Sound Art, Circuit Bending, Experimental Pop Music and Sonification, while also extending the journal's reach into new communities, voices and viewpoints. LMJ Editor-in-Chief Nicolas Collins expressed his gratitude for the many years of valuable support of LMJ Founder and Board Member Larry Polansky and LMJ Editorial Board Members Jody Diamond, Marc Battier and Ricardo dal Farra, who are stepping down from their posts this year. <www.leonardo.info/lmj>

Christoph Cox is Professor of Philosophy at Hampshire College and a faculty member at the Center for Curatorial Studies, Bard College. He is the author of *Nietzsche: Naturalism and Interpretation* (University of California Press, 1999) and co-editor of *Audio Culture: Readings in Modern Music* (Continuum, 2004). The recipient of a 2009 Arts Writers Grant from Creative Capital/Warhol Foundation, he has published essays in *Artforum, Cabinet, Journal of Visual Culture, Organised Sound, The Wire, The Journal of the History of Philosophy* and elsewhere. He has curated exhibitions at the Contemporary Arts Museum Houston, The Kitchen, New Langton Arts and G Fine Art Gallery. In 2011, Cox curated the Brick + Mortar International Video Art Festival in Greenfield, Massachusetts. He has written catalog essays for exhibitions at the Museum of Modern Art, the Whitney Museum of American Art, Mass MoCA, the South London Gallery, Berlin's Akademie der Künste, the Museum of Contemporary Photography and other venues. He is currently completing a philosophical book on sound art and experimental music.

Yan Jun, born in 1973 in Lanzhou, China, now lives in Beijing. He graduated from Northwest Normal University with a BA in literature. In the late 1990s he was involved with the Chinese underground rock movement as a critic and organizer. Around 2003, after this scene had dispersed, he started to make field recordings and then his own music. Since then he has organized hundreds of events under his label Sub Jam/Kwanyin Records. Yan Jun uses feedback as an open system of improvised music. He also works with site-specific sound to trigger people to feel lost, to think, to be mentally moved or to laugh. For more information, see <www.yanjun.org>.

Andrea Polli is a digital media artist, Associate Professor in Art and Ecology (Fine Arts and Engineering) and Mesa Del Sol Endowed Chair of Digital Media at the University of New Mexico. Her work with science, technology and media has been recognized by numerous grants, residencies and awards, including the National Science Foundation, the NYFA Artist's Fellowship, the Fulbright Specialist Award and the UNESCO Digital Arts Award. Her work has been reviewed by the *Los Angeles Times, Art in America, Art News, NY Arts* and others. She has published several book chapters, audio CDs, DVDs and papers in print, including in MIT Press and Cambridge University Press journals, and her most recent book is a collection of essays for Intellect Press co-authored with Jane Marsching called *Far Field: Digital Media, Climate Change and the Poles*. Her doctorate is from the University of Plymouth as part of the Z-node program under supervisor Jill Scott, and her MFA is from the School of the Art Institute of Chicago. From 2005 to 2008 she served as Director of the Integrated Media Arts Master of Fine Arts Program at Hunter College/CUNY. From 2006 to 2009 she was co-chair of the Leonardo Education Forum, an affiliate of the College Art Association of America (CAA). She was a founding co-chair of the New York Society for Acoustic Ecology, a multi-disciplinary group exploring the urban sound environment and a chapter of the American Forum for Acoustic Ecology, for which she now serves as Vice-President.

Tara Rodgers is a musician, composer and scholar. Currently Assistant Professor of Women's Studies and a Distinguished Faculty Fellow in Digital Cultures & Creativity at the University of Maryland, she holds an MFA in Electronic Music and Recording Media from Mills College and a PhD in Communication Studies from McGill University. Her collection of interviews, *Pink Noises: Women on Electronic Music and Sound* (Duke University Press, 2010), won the 2011 Pauline Alderman Book Award from the International Alliance for Women in Music; other publications have appeared in *Leonardo Music Journal, Leonardo Electronic Almanac, American Quarterly, differences* and *Organised Sound*. She is presently researching a cultural history of synthesized sound. Her compositions, ranging from multichannel sound installations created in SuperCollider to electronic dance music performed on MIDI instruments, have been presented internationally. <www.pinknoises.com/>

# Leonardo, The International Society for the Arts, Sciences and Technology

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Artists, scientists, engineers, researchers and others interested in the contemporary arts and sciences are invited to join Leonardo/ISAST. Benefits include reduced rates for Leonardo/ISAST publications, eligibility to participate in Leonardo working groups and special invitations to Leonardo-sponsored events.

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*Affiliate memberships also available for non-profit organizations, educational institutions and corporations working at the intersection of art, science and technology.*

**MISSION STATEMENT**
The critical challenges of the 21st century require mobilization and cross-fertilization among the domains of art, science and technology. Leonardo/ISAST fosters collaborative explorations both nationally and internationally by facilitating interdisciplinary projects and documenting and disseminating information about interdisciplinary practice.

## PUBLICATIONS

**Print Journals**
The *Leonardo* journals are scholarly peer-reviewed journals of record. *Leonardo*, published bimonthly, is the official journal of Leonardo/ISAST. *Executive Editor:* Roger F. Malina. *Leonardo Music Journal* with CD is published annually. *Editor-in-Chief:* Nicolas Collins.

**World Wide Web**
The Leonardo On-Line web site (www.leonardo.info) publishes organizational information, the Leonardo Electronic Directory and more. *Managing Editor:* Patricia Bentson.

**Electronic Journal**
*Leonardo Electronic Almanac* (leoalmanac.org) is an electronic journal dedicated to providing a forum for those who are interested in the realm where art, science and technology converge. *Editor-in-Chief:* Lanfranco Aceti. *Co-Editor:* Paul Brown.

**Leonardo Reviews**
The Leonardo Reviews Project, through a panel of reviewers, publishes reviews of relevant books, journals, electronic publications and events. Reviews are published on the Web (leonardo.info/ldr.html), and selected reviews are published in *Leonardo Electronic Almanac* and in *Leonardo*. *Editor-in-Chief:* Michael Punt.

**Books**
The Leonardo Book Series (leonardo.info/isast/leobooks.html), published by the MIT Press, highlights topics related to art, science and developing technologies. *Editor-in-Chief:* Sean Cubitt.

**Labs Databases**
Databases of master's and Ph.D. theses.
English LABS: <leonardolabs.pomona.edu>; *Coordinator:* Sheila Pinkel.
Spanish LABS: <www.uoc.edu/artnodes/leonardolabs>; *Coordinator:* Pau Alsina.
French LABS: <francolabs.univ-paris1.fr>; *Coordinator:* Annick Bureaud.

## AWARDS

**Frank J. Malina Leonardo Award for Lifetime Achievement** recognizes eminent artists who through a lifetime of work have achieved a synthesis of contemporary art, science and technology. Winners include Gyorgy Kepes, Nicolas Schöffer, Max Bill, Takis and Abraham Palatnik.

**Leonardo Award for Excellence** recognizes excellence in articles published in Leonardo publications. Winners include Rudolf Arnheim, Otto Piene, Charles Ames, Frieda Stahl, Donna Cox, Janet Saad-Cook, George Gessert, Alvin Curran, Karen O'Rourke, Eduardo Kac, Hubert Duprat with Christian Besson, José Carlos Casado with Harkaitz Cano, Bill Seaman, Arthur Elsenaar with Remko Scha, and Steve Mann.

**Leonardo New Horizons Award for Innovation** is given to individuals or groups for innovation in new media. Winners include Critical Art Ensemble, Gregory Barsamian, Graham Harwood, Evelyn Edelson-Rosenberg, Jean-Marc Philippe, Jaroslav Belik, Peter Callas, Patrick Boyd, Christian Schiess, Kitsou Dubois, I Wayan Sadra, and Ewen Chardronnet.

**Makepeace Tsao Leonardo Award** recognizes organizations or groups that have increased public awareness of art forms involving science and technology, particularly through exhibitions. The first award was given to La Cité des Arts et Nouvelles Technologies de Montréal.

**Leonardo Global Crossings Award** recognizes excellent work by international artists, professionals and scholars in the globally emerging art-science-technology field. Winners include Abdel Ghany Kenawy and Amal Kenawy (Cairo, Egypt) (2005).

**Leonardo-EMS (Electroacoustic Music Studies) Award for Excellence** is awarded for the best contribution to the EMS symposium by a young researcher, as decided by a joint jury. Winners include criticalartware (Jon Cates, Ben Syverson and Jon Satrom) and Michael Bullock (2008).

**Leonardo Art Science Student Contest Award** is a juried award for student work selected from projects received through an open submission process. The first Leonardo Art Science Student Contest award (2008) was given to Hiroki Nishino, Michiko Tsuda, Jaewook Shin, Byeong Sam Jeon, Margarita Benitez and Markus Vogl.

**The Leonardo Scholarship for Media Art Histories**, a collaborative project between Leonardo/ISAST and the Department for Image Science (Danube University), awards a juried half-tuition scholarship for the Master of Arts (MA) course in MediaArtHistories at Danube University to a candidate who demonstrates the potential to contribute to the new field of Media Art Histories in this time of critical worldwide challenges. The first scholarship has been awarded to Fran Ilich Morales Muñoz (2010).

## COLLABORATIONS WITH OTHER ORGANIZATIONS

Leonardo/ISAST frequently collaborates with other organizations on topics of current interest by collaborating on conferences or workshops and by publishing special sections in *Leonardo* or co-sponsoring events. Current collaborators include:

- ACM Multimedia
- ACM SIGGRAPH
- Ars Astronautica
- Artnodes (Spain)
- Association Leonardo (France)
- College Art Association (USA)
- Creativity and Cognition Studios, University of Technology Sydney (Australia)
- Donau University (Austria)
- Electronic Music Foundation (USA)
- Fondation Langlois Research Documentation Center (Canada)
- MIT Press (USA)
- Pomona College (USA)
- School of the Art Institute of Chicago (USA)
- The University of Plymouth (UK)
- Sabanci University (Turkey)

For more information, please visit <leonardo.info/collablist.html>.

## LEONARDO PROJECT WORKING GROUPS

Leonardo hosts working groups on projects with a topical focus:

**Cultural Roots of Globalization (FCM) Editorial Committee** Mark Beam, Annick Bureaud, Steve Dietz, Marina Grzinic, Roger Malina, Yukiko Shikata.

**Leonardo Education and Art Forum** Patricia Olynyk, *chair*; Adrienne Klein, *incoming chair*. See <www.leonardo.info/isast/LEAF.html> for more information.

**Leonardo Space Arts Working Group** Annick Bureaud, Richard Clar, Roger Malina, Jean-Luc Soret, Arthur Woods.

**Lovely Weather: On the Cultural Context of Climate Change Editorial Committee** Ramon Guardans, Annick Bureaud, John Cunningham, Andrea Polli, Janine Randerson, Jacques Mandelbrojt, Drew Hemment.

**Scientists' Working Group** Tami Spector, *chair*; Piero Scaruffi, Roger Malina, Robert Root-Bernstein.

**Artists and Scientists in Times of War Working Group** Michele Emmer, Sheila Pinkel, Ana Peraica, Randall Packer, Roger Malina.

## AFFILIATE MEMBERS

Leonardo/ISAST invites organizations and corporations working at the intersection of art, science and technology to join the Affiliate Membership Program. Visit <leonardo.info/isast/org-membership.html> for more information.

**Affiliate Members** Arizona State University Art Museum; CalArts, Herb Alpert School of Music; De Montfort University, Institute for Creative Technologies; Emily Carr University of Art & Design; Ontario College of Art & Design; Plymouth University; Pomona College; School of the Art Institute of Chicago; School of Visual Art Computer Art Dept.; UCLA Art|Sci Center; University of Calabria, Evolutionary Systems Group; University of Caldas, Arts & Humanities; University of Technology, Sydney, Creativity & Cognition Studios; University of Texas at Dallas, Arts and Technology.

## LEONARDO/ISAST BOARDS AND COMMITTEES

**Leonardo/ISAST Governing Board of Directors**
Greg Harper, *chair, president*; Gordon Knox, *secretary*; Roger Malina, *chair emeritus*; Nina Czegledy; Marc Hebert; Melinda Klayman; Tami Spector; Darlene Tong.

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Patricia Bentson, Pamela Grant-Ryan.

**Book Series Committee**
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**GET THE WORD OUT**

**Announce a job opportunity, new project, publication or upcoming event to Leonardo's targeted community.**

**Option 1: classified ad in print journal**
Present a short, text-only message to *Leonardo* and *Leonardo Music Journal* subscribers. *Leonardo* is published bi-monthly and *LMJ* is published annually.

**Option 2: classified ad in email newsletter and on web**
If you want to get the word out far and fast, you can present your message to the Leonardo community in the Leonardo Network Newsletter. Your ad will also be posted on the Leonardo On-Line website.

**Option 3: display or full-page ad in print journal**
If your ad includes graphics, you can place a display ad or a full-page ad in *Leonardo* or *Leonardo Music Journal*.

For rates, schedule deadlines and payment options, visit: <leonardo.info/isast/placeads.html> or email the Leonardo Editorial Office: <ads@leonardo.info>.

**Leonardo/ISAST members will receive a 20% discount!**

**SPACES OF LIFE: THE ART OF SONYA RAPOPORT.** Exhibition curated by Terri Cohn and Anuradha Vikram, 18 January–11 March 2012, at Mills College Art Museum, Oakland, CA, U.S.A. Opening reception on 18 January 2012, 6:00–8:00 P.M. The art of Sonya Rapoport has long operated as a bridge between the public sphere of intellectual curiosity and scholarship, and the domestic one of spiritual inquiry and nurturing. Spaces of Life presents a group of Rapoport's interactive works, created between 1980–2011, that function in the intersection between questioning and inviting. The installation is structured so as to infuse the spaces of the museum with the energy of the artist's Berkeley home and studio. The exhibition presents a mixture of documentation of original interactive installations, domestic objects that provide a launching pad for interactions, and new interpretations of interactive works that will be developed in conjunction with Mills students and departments. Visitors to the gallery will engage in ongoing, distributed performance actions that draw on imagery and ideas from a range of disciplines including biochemistry, anthropology, psychology, and feminist studies. Central to this installation of Rapoport's work at Mills is *Objects on My Dresser* (1979–1983), an 11-phase work intended as a kind of "conceptual visit" to the artist's home and studio. *Objects on My Dresser* will be contextualized by other works that consider domestic concerns through the lens of academic and scientific research. Visit Mills College Art Museum, 5000 MacArthur Blvd., Oakland, CA 94613, U.S.A. Information: (510) 430-2164. Directions: (510)430-3250. Email: <museum@mills.edu>. Hours: Tuesday–Sunday 11:00 AM–4:00 PM; Wednesdays 11:00 am–7:30 pm; closed Mondays. Admission: Free for all exhibitions and programs.

***ERROR: GLITCH, NOISE, AND JAM IN NEW MEDIA CULTURES,*** edited by Mark Nunes, brings together established critics and emerging voices to offer a significant contribution to the field of new media studies, exploring the ways in which error can serve as a critical lens for understanding the principles of informatic control that govern our contemporary network society. By offering a timely and novel exploration into the ways in which error and noise "slip through" in systems dominated by principles of efficiency and control, this collection provides a unique take on the ways in which information theory and new media technologies inform cultural practice. For more information visit: <www.continuum books.com>.

**The WIRED Lab** is an art + science project investigating æolian instruments that sonically capture the magnificent and dynamic universe of the natural world. Based in rural southwest NSW, Australia, WIRED Lab was established in 2007 to ensure the legacy of The Wires, a unique and distinctly Australian invention that primarily exists in rural landscapes. The Wires are inherently interdisciplinary with foundations in sculpture, environmental/land art, sound composition, interactivity, behavioral constructs of old/new media, bio-resonance, physics and complex systems sciences. We host research residencies and workshop programs for artists and scientists; for more information go to: <http://wiredlab.org>/.

***ECOTONES*** is a data-ecological project by Janine Randerson that employs information from satellite telemetry and sonification of the paths of migratory birds from the Northern hemisphere to the Southern hemisphere. The bar-tailed godwit, a bird with the longest non-stop migration of any species, arrives annually in Miranda, an estuary in New Zealand's North Island. This area is an "ecotone" or transitional space between terrestrial and marine ecosystems, where land meets sea, saltwater meets freshwater. The birds are arriving to New Zealand in smaller numbers due to the lack of seasonal availability of foods, a predicted consequence of climate change, and the historical lack of human care for the ecotones, regarded as unwanted, hybrid spaces. Ecotonal space and the flight of the migratory birds are reconceived visually and acoustically in this installation to work against the atomization of North/South, human/non-human, air, sea and earthly relations. *Ecotones* will be developed at the SCANZ: Eco Sapiens residency in New Zealand in 2011. "Eco sapiens seeks to bring a range of worlds together to investigate the cultural roots of climate change, and explore poetically pragmatic approaches to encouraging the long-term cultural shifts required." Trudy Lane, <http://intercreate.org/view/eco-sapiens>. Janine Randerson is also a participant in the Data Ecologies workshop series (2010–2011) conceived by Tom Corby, University of Westminster; "The politicization of climate data, whilst potentially dangerous, offers opportunities for us to re-think our relationships to science and develop discussion around interdisciplinary art/science approaches to our changing environment." Tom Corby, 9 August 2010 <http://data-ecologies.ning.com>.

***THE CAMBRIDGE LITERARY REVIEW*** is a new print journal of poetry, fiction and essays. It is committed to publishing interdisciplinary work: essays have covered such topics as Otto Neurath's picture language Isotype, poetry and politics, Hume, Hegel and Walter Benjamin, as well as traditional literary criticism. Issue 3 (June 2010) is dedicated to translation and contains an essay by the composer Peter Zinovieff on the subject of analogue-to-digital music translation. *The Cambridge Literary Review* is available to purchase from <www.cambridgeliteraryreview.org>, and costs £8 for one issue, £20 for a 1-year subscription (3 issues).

**REPRESENTATIONZ** is a new blog covering how symbols, images and language affect our daily lives—from representation in art, science and culture to cryptic puzzles. The blog is run by Paul Fishwick and can be viewed on the web or via smartphone apps. Twitter and RSS feeds are available. See <www.representationz.com> for more details.

**THE DIATROPE INSTITUTE** has partnered with Amazon.com to create an online bookstore specializing in art, science and technology titles. Our stock includes both new and used items. We will also search for and special order hard-to-find books in the field. Please visit us at <www.diatropebooks.com>. For more information e-mail us at <info@diatropebooks.com>.

**THE THURSDAY CLUB.** An open forum discussion group for anyone interested in the theories and practices of cross-disciplinarity, interactivity, technologies and philosophies of the state-of-the-art in today's (and tomorrow's) cultural landscape(s). Originally set up in October 2005 by GDS, the Club has grown to include 300 members: artists, technologists, scientists—in fact, a growing diversity of people from different communities worldwide who are connected via a mailing list and online forum. Organized and supported by the Goldsmiths Digital Studios (GDS) and the Goldsmiths Graduate School, Goldsmiths, University of London, U.K. <www.thethursdayclub.net/>.

# Classified Advertisements

***INTERACTIVE ART RESEARCH,*** Gerfried Stocker, Christa Sommerer, Laurent Mignonneau (Eds.), 2009. Springer Verlag Vienna/New York, ISBN: 978-3-211-99015-5. English, with DVD, <www.springer.com/springerwiennewyork/art/book/978-3-211-99015-5>. This monograph represents a comprehensive overview of Sommerer and Mignonneau's art and research. In addition to providing detailed project descriptions of each interactive artwork, it includes essays and articles by highly recognized media scholars and theoreticians such as Peter Weibel, Christiane Paul, Mathias Michalka, Itsuo Sakane, Erkki Huhtamo, Christine Schoepf, Hannes Leopoldseder, Ingeborg Reichle, John L. Casti, Machiko Kusahara, Tomoe Moriyama, Florence de Mèredieu, Oliver Grau and Roy Ascott.

**CHUA's CIRCUIT WEBSITE.** The Evolutionary Systems Group (ESG) presents CHUA's CIRCUIT <http://160.97.10.253/chuaweb/>, collecting Chua's different Attractors, videos, music, sound and animations. The website shows new forms of digital art and has as starting point six papers with the title "The Gallery of Chua's Attractors," published in six consecutive issues, since January 2007, in the International Journal of Bifurcation and Chaos. The six papers, together with a CD-ROM containing music from Chaos, have become a book with the same title. An experimentation with high school students on chaos is the main focus of this site.

**SYMMETRY BOOKS.** *Visual Symmetry* by Magdolna and Istvan Hargittai (World Scientific, 2009) is a pictorial presentation in full color, including over 500 photographs from all over the world with easy yet accurate and systematic explanations of the simplest to the most complex occurrences of symmetry in the world around us. *Symmetry through the Eyes of a Chemist*, Third Edition, by Magdolna and Istvan Hargittai (Springer, 2009) is a systematic journey through chemistry from the point of view of symmetry. An independent reviewer claimed about the first edition: "The most delightful book on symmetry ever written!"

**DIRECTORY OF UNIVERSITY PROGRAMS IN THE ART SCIENCE TECHNOLOGY FIELDS.** Leonardo/OLATS, co-sponsor of YASMIN, is pleased to bring the following resource to your attention: Pier Luigi Capucci, co-moderator of the YASMIN list, has started a resource of academic courses on arts/sciences/technologies, including a directory of existing directories. In Europe it will be of particular interest to students interested in the ERASMUS program for student mobility. The resource can be found at: <http://www.noemalab.org/sections/projects/edu/>. If you are running a program and wish to be included please send your information and link to: <staff (at) noemalab.org>.

**MASTER OF RESEARCH IN COMPUTER MUSIC.** The computer is becoming increasingly ubiquitous in all aspects of music. The new MRes in Computer Music at the University of Plymouth (UK) provides an exciting opportunity to pursue a research project of your choice while enhancing your career with a post-graduate academic qualification. Projects range from the development of music technology to musical practice using computers. The training conveys skills necessary to progress to more advanced research towards a Ph.D. The course is delivered in the context of the Interdisciplinary Centre for Computer Music Research (ICCMR). For more information, please contact Eduardo Miranda <eduardo.miranda@plymouth.ac.uk>.

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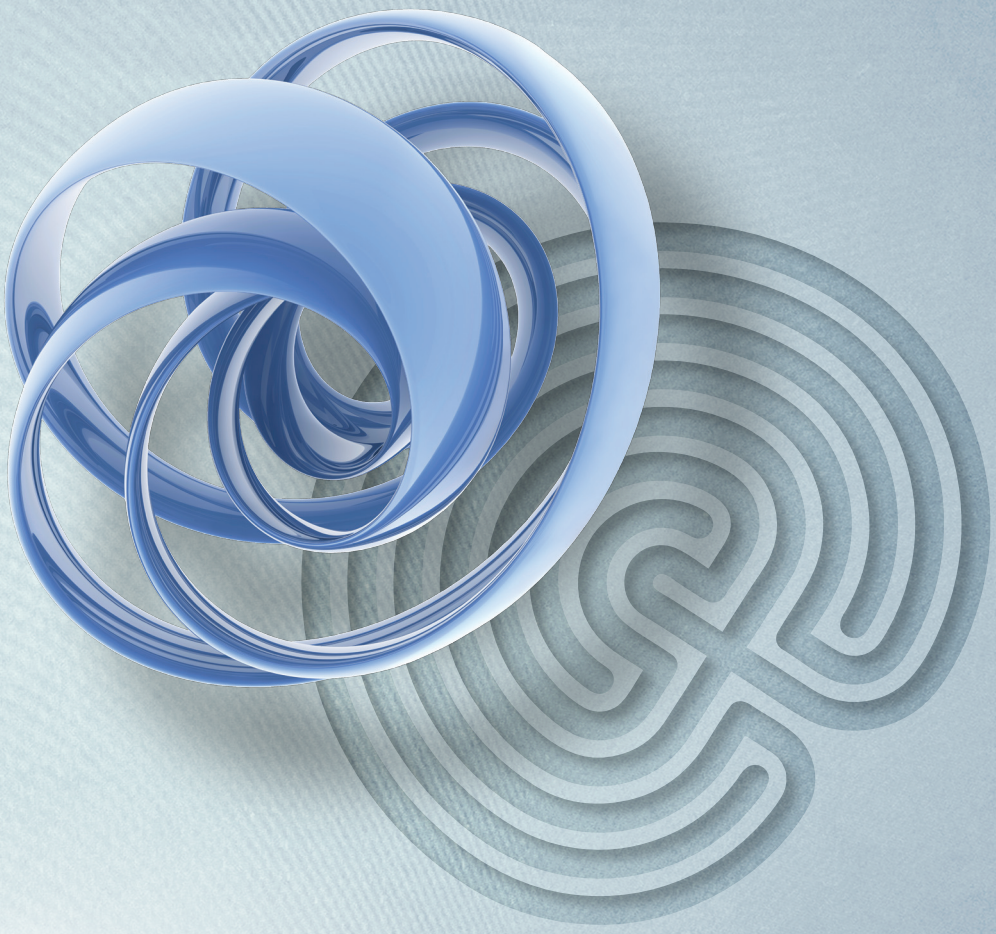
**LIGHT-MUSIC, SYNESTHESIA, "COLOR HEARING":** annotated bibliography (Russia, 1742–2002). The Prometheus Research Institute (Kazan, Russia) has recently published a unique bibliography of nearly all Russian publications on synesthesia, "color hearing" and related experimental arts such as light-music, abstract musical films, inter-media compositions, etc. (compiled by scientific editor Bulat Galeyev). The bibliography covers the last 260 years and includes nearly 2500 titles of books, journal articles and conference theses. As these works are little known in Western countries, Prometheus Institute suggests a project of making an English version of the bibliography (printed and on-line) with abstracts in English for each item. The project can be realized given sufficient financial support. We will be very grateful for any grants or donations from interested organizations. Publications by the Prometheus Institute are currently available online at: <http://synesthesia.prometheus.kai.ru>.

**THE CONCEPTUAL INFORMATION ARTS (CIA) PROGRAM AT SAN FRANCISCO STATE UNIVERSITY'S ART DEPARTMENT** stresses experimental art at the juncture of science, technology and culture, offering both BA and MFA degrees. Contact Paula Levine. Web site: <http://userwww. sfsu.edu/~infoarts/>. Tel: (415) 338-2291.



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