Speculative Data and the Creative Imaginary

shared visions between art and technology

National Academy of Sciences

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Speculative Data and the Creative Imaginary

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and technology

Pamela Jennings, Ph.D., Curator

June 4, 2007 – August 24, 2007

Rotunda Gallery
National Academy of Sciences

2101 Constitution Ave, NW
Washington DC 20418

Foreword

Dr. Wm. A. Wulf, President National Academy of Engineering of the National Academies, (July 1996 to June 2007)

My PhD diploma says that I'm a Computer Scientist – an old Computer Scientist! I wrote my first computer program almost fifty years ago. One of my observations from all those years of watching the field mature is that the "first use" of computers in a new area is to automate what we had been doing manually – but the profound use is to change what we are doing.

Around 1965 an undergraduate, Lloyd Summner, asked me whether he could use the plotter on the University of Virginia mainframe to produce art. One of his works still hangs on my home study wall, but sure enough, he automated what could have been done with manual drafting tools.

What we see in this exhibit, if not the profound use of computers in art – only time can judge that – certainly moves in that direction. In different ways, these artists are not just using the computer to render their work, but rather are exploiting the algorithmic nature of computers to create changing, evolving, interactive, interpretive or personalized experiences. I find that very exciting; I don't see how it can fail to fundamentally change our notions of what art is – and reciprocally, how computers in the arts might influence technology research and development.

Dr. William A. Wulf is currently the President of the National Academy of Engineering (NAE). Together with its sibling, the National Academy of Sciences, the NAE is both an honorific organization and an independent, authoritative advisor to the government on issues involving science and technology. Earlier, Dr. Wulf was an Assistant Director of the National Science Foundation, Founder and CEO of Tartan Laboratories, and a Professor of Computer Science at the University of Virginia and Carnegie Mellon University. Dr. Wulf is a member of the National Academy of Engineering, a Fellow of the American Academy of Arts and Sciences, a Corresponding Member of the Academia Espanola De Ingeniera, a Member of the Academy Bibliotheca Alexandrina (Library of Alexandria), a foreign member of the Engineering Academy of Japan, and a Foreign Member of the Russian Academy of Sciences. He is also a Fellow of five professional societies: the ACM, the IEEE, the AAAS, IEC, and AWIS. He is the author of over 100 papers and technical reports, has written three books, holds two US Patents, and has supervised over 25 Ph.D.'s in Computer Science.

What is this stuff and why is it here?

JD Talasek, Director
Office of Exhibitions and Cultural Programs
National Academy of Sciences

If the commonly held stereotypes of artists and engineers hold true, then certain epistemological attitudes are often assumed. The artist will look at the engineer's lab and white boards and declare, "I don't understand it. It must be brilliant!" Conversely, the engineer enters into a contemporary art gallery and states, "I don't understand it. It must be useless." But in a time when cross-disciplinary discussions are almost trendy, the hard edges of both camps are blurring together and the stereotypes are slowly beginning to dissolve into outdated myths. Many artists are entering science and engineering labs to gain expert knowledge of the subject matter, adding authority to their work. Scientists and engineers, whose work is rocketing ever deeper into abstraction, continuously seek new ways of representing complexity – often looking to the artists' processes for inspiration. The end result makes it difficult at times to apply labels such as "artist" and "engineer" in a traditional manner.

So the "stuff" in this exhibition is the physical manifestation of the shifting attitudes across disciplines. A function of art is to observe and critique the values and priorities of the society in which it is created. Arguably, there are few other forces that have impacted our lives more than computing technology, so it is no surprise that contemporary artists would find a rich new vocabulary within these advancements. The work in this exhibition, produced by the leading engineer-artist hybrids of the field, provides a platform on which to discuss the impact of technology on society, culture, ethics, and even our own personal identity.

Why is it here? What better place could there be? Exhibiting artwork in a space associated with science, medicine, and engineering provides a unique context where layers of interpretation, that might not otherwise exist, can be woven throughout the work.

The Office of Exhibitions and Cultural Programs of the National Academy of Sciences is pleased to exhibit Speculative Data and the Creative Imaginary. We thank curator Pamela Jennings for her work, dedication, and vision. We would also like to thank the exhibition's co-sponsors: the Association for Computing Machinery (ACM) with special gratitude to Ben Shneiderman (ACM Creativity & Cognition chair) and Elisa Giaccardi (ACM Creativity & Cognition program chair). Special thanks to Mary Lou Maher, from the National Science Foundation CISE Creative IT program. Most importantly, we wish to thank the artists not only for participating in the exhibition but for their participation in the larger dialogue.

Robin Oppenheimer

The Conversation Continues: When Artists and Engineers First Collaborated

"...Collaboration enables the artist to obtain practical knowledge otherwise unavailable. He becomes familiar with his material. He discovers precisely what an audio circuit or a computer can do, when taken out of its original functional context. More often than not, he exploits what he knows far beyond the initial collaboration. He liberates the machine in spite of himself. He also liberates the engineer, to the point where the split between artist, engineer, and even machine ultimately disappears."[1]

It is hard to imagine, looking at the wonderfully diverse artworks presented in the exhibition Speculative Data and the Creative Imaginary: shared visions between art and technology, that the first large-scale collaboration between artists and engineers took place just over forty years ago, October 13-23, 1966 at the 69th Regiment Armory in New York City, as a series of performances called "9 Evenings: Theatre & Engineering." Twenty performances were presented over the nine-day event to an audience of more than ten thousand people. The "9 Evenings: Theater & Engineering" event happened through the connections of a complex social network of friendships and professional relationships that had developed in New York City since the 1950s and early 1960s. When Bell Labs engineer Billy Klüver helped artist Jean Tinguely create a self-destructing machine called "Homage to New York" in the garden of the Museum of Modern Art in 1960, Robert Rauschenberg introduced himself to Klüver and asked him to help create an interactive artwork. That began a life-long friendship and instigated the then-unheard-of concept of artists and engineers collaborating to make art together using new communications and other experimental technologies being explored and developed by Bell Telephone Laboratories engineers at the Murray Hill campus. Through Rauschenberg, Klüver was introduced to a multi-talented array of artists, musicians, and dancers that included Merce Cunningham, John Cage, and the loose collective known as the Judson Dance Theater with members Deborah and Alex Hay, Yvonne Rainer, Lucinda Child, and Steve Paxton, among many others.

The artists involved in the "9 Evenings: Theater and Engineering" event included John Cage, Lucinda Childs, Öyvind Fahlström, Alex Hay, Deborah Hay, Steve Paxton, Yvonne Rainer, Robert Rauschenberg, David Tudor and Robert Whitman. Their ten-month collaboration with 30 engineers and scientists from Bell Labs was focused on the goal to adapt and develop new communications technologies to be used as integral components of the artists' performances. The significance of this 1966 event, along with the subsequent formation of Experiments in Art and Technology (E.A.T.) collectives, is just beginning to be explored. There is much to be learned from the historical reasons these different worlds of science and art first came together.

1960's an Era of Revolutions

The artists involved in this event were a subset of a larger eclectic community of avant-garde musicians, dancers, painters, performers, sculptors, filmmakers, and poets who lived in Greenwich Village, and who had already developed a strong work ethic of democratic collaboration and collective, experimental artmaking. This new American avant-garde emerging out of the Beat Generation included Andy Warhol, Jasper Johns, John Cage, Nam June Paik, and Allan Kaprow, among many others, and they were creating and defining the major art movements of the day, including Pop Art, Conceptual Art, Happenings, Performance Art, Underground Films, Video Art, New Music, Fluxus, and Postmodern Dance. They also instigated a revolutionary breaking down of boundaries between different arts disciplines, when musicians were performing with dancers, painters were making theatre, and new forms of image and sound recording technologies such as film and audiotape (and later video and computers) were starting to become more accessible and incorporated into creative processes.

The AT&T research think tank Bell Telephone Laboratories was founded in 1925 in Murray Hill, New Jersey. Here too something equally revolutionary was happening in the 1960's. Tucked away in the foothills of New Jersey, not far from New York City, an interdisciplinary group of scientists and engineers were encouraged to transform technologies developed for World War II defense purposes into new technologies for society and a rapidly expanding consumer marketplace. As a result, a free-wheeling place emerged where engineers invited experimental musicians to work with them to explore acoustics. One product from this interdisciplinary approach to technology research was the first computer music program written by Bell Labs Director of Acoustic and Behavioral Research Max Mathews in 1957.

Intentional Collaboration

"For better or worse, '9 Evenings' put both the engineer and his media on equal footing with the 'artist,' whatever that term had come to mean. Rauschenberg had once spoken of collaborating with the neighborhood in the creation of his combines. Now he was collaborating in a very real sense with contemporary electronics, in the creation of 'Open Score.' Without those wired tennis rackets and infrared television sets, the piece could not have existed. The object of collaboration between artist and engineer, Kluver pointed out, is a work neither could have created alone."[2]

The "9 Evenings" event was the culmination of an intentional experiment in creative collaboration between ten artists who had been working together for many years and engineers who had barely met the artists or seen their work. Although judged a failure for the most part by journalists and art critics at that time, it is now seen as a watershed event that introduced the idea of bringing the worlds of engineering and art together. Avant-garde artists from an insular urban village in New York City consciously reached beyond their world to communicate and create something bigger than themselves. And engineers working in the New Jersey suburbs in a rarefied Cold War technology research laboratory spent their nights and weekends trying to adapt new technologies to do things like turn off lights in an auditorium every time a tennis ball was hit by a racket. They were all driven by a shared collective goal of inventing more humane uses for the new technologies, and their brave experiment quickly resonated throughout the international art and engineering worlds via writings, photos, and a short film produced and circulated by the newly-formed Experiments in Art and Technology (E.A.T.). Founded in New York as a non-profit networking organization soon after the "9 Evenings" by Rauschenberg, Klüver, Robert Whitman, Fred Waldhauer, and others, local chapters of E.A.T. were quickly established around the U.S. and in other countries as the concept of matching engineers with artists to create new technology-based artworks caught the imagination of both worlds.

The historic collaboration of these artists and engineers from two different subcultures that produced the "9 Evenings" event can be traced, in part, to the earlier collaborative, interdisciplinary, and entrepreneurial styles of working invented in both the American avant-garde arts scene in Greenwich Village and the network of military-industrial-academic research laboratories of World War II such as Bell Labs, where theories of cybernetics and information systems were initially conceived. For example, composer John Cage, the son of an engineer, connected the worldview of Norbert Wiener's cybernetics theories of information systems linking humans and machines to art making practices that influenced a generation of artists. Both groups shared an emerging set of values and work practices that included open, egalitarian approaches to experimentation; discipline boundary-crossing; respect for technology as a tool, and a project-based approach to creative research and production influenced by theories of cybernetics where information was envisioned to circulate freely between human and machine systems.

The bohemian artists were inventing collaborative processes based on cooperative ventures of shared power and authority. Their core beliefs rooted in democratic equality and freedom emphasized the qualities of no hierarchies and focused on power that comes from expertise and ability rather than role or title. These were artists who were open to experimentation and new ideas, and

who routinely came together to share and create something bigger and more interesting than could be done alone in the studio. They understood Marshall McLuhan's media theories that discussed the role media plays in shaping our consciousness and promoting the development of a global village. Artists were starting to use media technologies, e.g. television, audiotape, film, as tools for creative expression. As these trends increased, artists wanted more access to them. So when Billy Klüver came into their midst, with his interest in bringing artists and engineers together to create new, more humane uses for technologies, everyone was more than ready.

The engineers were also ready. World War II radar research had attracted scientists from universities all over the country to Bell Labs to work in an open environment of cross-disciplinary experimentation. Spurred in part by the Cold War nuclear threat and the space race to the moon, this research focus was maintained throughout the '50s and '60s. Claude Shannon, a student of Norbert Wiener, invented a mathematical Information Theory of how information circulates while working at Bell Labs in 1948. Bell Labs engineers John Pierce and Max Mathews understood the value of bringing in artists who could explore other uses for the new technologies being invented there, such as sonar and computers. James Tenney, an avant-garde composer who lived in the Village, had been an artist-in-residence at Bell Labs in the early '60s, working with acoustic technologies pioneered by Mathews. Engineers with artistic talents were encouraged to explore new technologies. Billy Klüver, who brought the "9 Evenings" project to his engineer colleagues, had been hosting picnics for his artist friends at Bell Labs as he worked with Rauschenberg. Although not officially supported or sanctioned by Bell Labs, the engineers caught the collaborative spirit of the project and, like the artists, worked for no money and gave up their nights and weekends to make the event happen.

Creating a Culture of Collaboration

"Because artists and engineers had no common ground in these early discussions, communication was difficult. The engineers rejected many if not most of the artists' proposals as unfeasible. Artists, on the other hand, found it difficult to work within a situation with such distinct parameters. As a solution, Rauschenberg suggested collaboration on a one-to-one basis, each artist and engineer having an equal responsibility. During the summer of 1966, this one-to-one collaboration was adopted as a working principle.... Perhaps the most important function of '9 Evenings' was to define the nature and basis of a collaboration, and to acquaint artists and engineers with new ways of thinking; involving areas in which the practical and the creative would interact. '9 Evenings,' in other words, defined the problems rather than providing any solutions...Above all, it illustrated the enormous complexity of integrating diverse kinds of specialized thinking."[3]

The artists and engineers involved in the "9 Evenings" event were clear from the start that they wanted to make the collaborative process their mode of operation. They pioneered and practiced a creative process forty years ago that is just beginning to be widely adopted in the worlds of business, education, art, and technological innovation. An entire field of study is now devoted to defining and implementing the elements of a successful creative collaboration in order for groups or businesses to succeed in a climate of rapid innovation, constant change, and economic uncertainty. This attitude of sharing and working together was pervasive among both the artists and the engineers. They all knew the importance of bringing together different views and talents from the experimental nature of their work in both the arts and the applied sciences. Thus, they already shared a common culture of collaboration in their willingness to work with people who had very different skills, interests, and points of view.

The "9 Evenings" event occurred during a time of transformational change in both the traditional art world and the scientific community, when age-old categories, ideas and practices were being rejected for new, more holistic and interdisciplinary approaches to creative experimentation and art making. Artists and scientists both were expanding their consciousness through their contact with visionary thinkers like Marshall McLuhan and Buckminster Fuller, and through their exposure to the Counterculture's adoption of psychedelic, mind-altering drugs, Native American myths, and Eastern philosophies that taught different ways of seeing the world. The artworks of the day that were being produced, in the forms of multi-media performances, light shows, and Happenings, were a new form of group consciousness-raising, uniting the audience and the artists in an immersive environment of light, sound, images and motion that prefigures virtual reality and other information technology-rich creative practices. These new

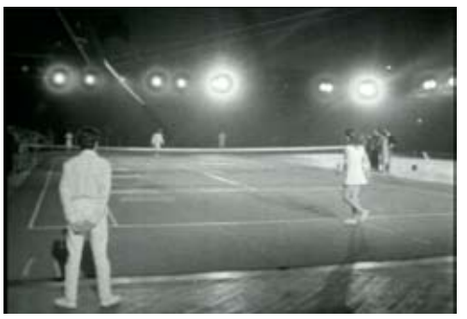
forms of creative, collective practices also portended a shifting paradigm in our worldview towards collaboration and the higher-level consciousness of group wisdom that can now be facilitated even more ubiquitously by the new communications technologies. So let the conversation continue!

1. Davis, D. (1973). Art and the Future: A History/Prophecy of the Collaboration Between Science, Technology and Art, New York: Praeger Publishers, pp. 71-72.
2. Ibid., 72.
3. Kluver, B., Martin, J., and Rose, B., editors. (1972). Pavilion by Experiments in Art and Technology, New York: E.P. Dutton and Co., pp. 93-4.

Special Event

Thursday July 12, 2007
5:00 - 7:30 PM
National Academy of Sciences Auditorium
2100 C St. N.W., Washington D.C.

Julie Martin, producer of the 9 Evenings DVD series, will introduce and screen the film on Robert Rauschenberg's Open Score, the first of the 9 Evenings DVD Series to be released. This film is an important documentation of Rauschenberg's work and the 1966 collaboration between the artists and engineers in the 1960's. The Open Score is co-produced by E.A.T. and ARTPIX and distributed by Microcinema International.



Still from the film "Open Score", 1966.

Robin Oppenheimer is an internationally-recognized media arts consultant, historian, curator, writer, and educator who has worked in the field since 1980. She was the Executive Director of 911 Media Arts Center in Seattle and IMAGE Film/Video Center in Atlanta, where she also directed the Atlanta Film & Video Festival. In addition, she has produced numerous large-scale media arts projects, curated video art exhibitions and festivals, written about the media arts field, taught fundraising and media arts history and aesthetics, and established an Open Studio website training center for artists and arts organizations at the Seattle Art Museum. As the first (and only) Media-Arts-Historian-In-Residence at the Bellevue Art Museum in 2000-02, she researched and presented a TV show and exhibition about the history of the experimental Bellevue Film Festival (1967-81). She also researched and helped produce the E.A.T. Reunion Symposium at the University of Washington in 2002 that brought together members of regional E.A.T. chapters in Seattle and Portland organized in 1967 with E.A.T. founding members Billy Kluver, Julie Martin, and Robert Whitman. Currently based in Seattle, she is a Ph.D. candidate in the School of Interactive Arts and Technology (SIAT) at Simon Fraser University in Vancouver, Canada, where she is researching the collaborative origins and practices of the historic "9 Evenings: Theatre and Engineering" event.

Pamela Jennings

When Practices Converge and Transform

The Speculative Data and the Creative Imaginary: shared visions between art and technology exhibition presents a confluence of multidisciplinary research and creative practices that involve the visual arts, design, architecture, performance, science, technology and engineering. The exhibited works focus on computer mediated experiences, technology development, aesthetic practices and cultural criticality that celebrate imaginary scenarios and real-time phenomenon from the outer space to cyberspace, collective space to urban space, public space to embodied space, and ecological space to dialogical space. The exhibited works demonstrate innovative, novel, sometimes provocative and other times promising models for research. The exhibition is part of the program for the ACM Creativity and Cognition conference held in Washington D.C. June 13 – 15th, 2007.[1] The conference themes cultivating creative minds, sustaining creative communities and promoting creative engagement, describe the landscape by which the creative digital media works in the exhibition have been realized. Speculative Data and the Creative Imaginary presents an opportunity to re-open and continue a dialogue between "communities of practice" in fields of creative production and technology research.[2] As part of the ACM Creativity and Cognition conference this dialogue broadens to include the Creativity and Cognition community of university and industry researchers. This is an opportunity to identify and foster common research questions that span across these communities and have found voice in a variety of white papers on the phenomenon of creativity lead research and innovation including the New Media Art | New Funding Models Rockefeller Foundation Report, Beyond Productivity: Information Technology, Innovation, and Creativity, published by the National Research Council of the National Academies; and the Helsinki Agenda.[4,6,7] These reports highlight creative digital media works by an international community of creative practitioners and technical wizards who are acting on the premise that "information technology (IT) is forming a powerful alliance with creative practices in the arts and design to establish the exciting new domain of information technology and creative practices (ITCP)", by blurring the lines between aesthetic production and technology development to form new hybrid productions.

The selection of works in the Speculative Data and the Creative Imaginary exhibit represent a group of creative practitioners who are forging new paths in that international ITCP community. Sabrina Raaf (University of Illinois at Chicago, USA) states that "as an artist, it is extraordinarily exciting to create a work that takes on a life and function of its own – and which can itself create things that are unexpected and unpredictable". Known best for her explorations with electronics and wearable experiences, her Test People large digital prints depict a future time when the capacity for human flight are tested in everyday environments, and fictitious scientific labs. Digital prints from Pamela Jennings' Ph.D. (Carnegie Mellon University, USA), Sui Generis series explore the relationship and contestations between the visceral human body and sciences of the artificial. Symbols of logic and devices of precision form the frame in which physiological machines are viewed. Based upon the insight that interaction per se and the interrelation between entities are the driving forces for the structures of life, Christa Sommerer, Ph.D. and Laurent Mignonneau, Ph.D. are investigating the interaction and creative process in their work "Life Spacies II" an artificial life interactive fictional ecology. Ernest Edmonds' Ph.D. (University of Technology, Australia) Shaping Forms Series bridge the modernist color field art movement with reactive interactive systems. The work encourages the contemplation of the role of interactivity not only as a system of participant choice, but as a cybernetic feedback loop in which the human and computer system have profound effect on each other's state. Whereas Edmonds' work explores interactive feedback in the visual realm, Roger Dannenberg's Ph.D. (Carnegie Mellon University, USA) Resound! Fanfares for Trumpet and Computer, is a computationally rich dialogue between the acoustic trumpet and the real-time computer response. Despite the technical accomplishments of this composition Dannenberg states that "... the real challenge is always to write and perform music that captures the imagination and carries the listener to a new and wonderful place."

Rennaissance Teams of the 21st Century

The alliance between creative production and engineering has roots as far back as the 1801 Jacquard's Loom, which is perhaps the first computationally driven creativity support tool designed to facilitate the craft of weaving. Fast forward to the mid 20th century and we find the 9 Evenings: Theater & Engineering event in 1966 and the Experiments in Art and Technology (E.A.T.) collaborations between a group of New Jersey AT&T engineers and New York City installation and performance artists including Robert Rauschenberg, Lucinda Childs, and John Cage. Robin Oppenheimer's (Simon Fraser University, Canada) catalog essay The Conversation Continues: When Artists and Engineers First Collaborated presents an overview of the 1966 event and the impact of the newly speculated interfaces and control systems in setting the ground for the next fifty years of dialogue about the synergies between creativity, technology research and development.

Yes, the conversation does continue! But its structure has evolved. Rather than a dialogue drawing a tenuous bridge across the great chasm that separates the arts and sciences, the conversation now intertwines through overlapping, merged, and often transformed fields of practice where the artists is engineer or the engineer is artists, thus begging the question whether these titles of occupation and perspective are adequate or appropriate. The works in Speculative Data and the Creative Imaginary are examples of contemporary practice where the lone visionary and/or the collaborative team take on the descriptive term "renaissance." The "renaissance team" is a term coined by exhibition participant Donna Cox, Director of the Advanced Scientific Visualization Laboratory at the National Center of Supercomputing Applications (NCSA) (University of Illinois at Urbana-Champaign, USA). The NSF CreativeIT program describes a goal to support work "done with groups of people from different backgrounds in which the creative synergy is focused on a specific context, problem, or perceived need... resulting in new products, models, and areas of research". This is but another way of describing the phenomenon of the renaissance team.

Works by renaissance teams in Speculative Data and the Creative Imaginary have been developed to engage participants in experiencing phenomena that is so small or so grand that it exists beyond the periphery of human senses, whereas other works present alternative experiences of objects and actions in our everyday environments. Visualizations from the NCSA Advanced Scientific Visualization Laboratory that make the invisible visible depict black holes and ocean flows, the birth of stars and colliding galaxies. Marcos Novak's (University of California at Santa Barbara, USA) Allosphere project searches for the physiological location where aesthetic aptitude germinates. Following his seminal theories in liquid architecture and transarchitectures, this work involves the integration of fMRI scans and nanotechnology as creative methods. Thecla Schiphorst's (Simon Fraser University, Canada) work Exhale: breath between bodies is part of the whisper[s](Wearable technologies that enhance the experience of one's environment with movement and touch) project. The work explores the design and fabrication of wearable body networks for public spaces where movement and gesture are sensed and shared across the network through specially designed garments. Nell Breyer's (Massachusetts Institute of Technology Center

for Advanced Visual Studies, USA) i: move* explores how we perceive movement patterns in public spaces. The work articulates this using painterly methods that emphasizes patterns of movement across a flow of time. Bill Seaman's Ph.D. (Rhode Island School of Design, USA) Hybrid Invention Generator is an interactive realization of his theory of recombinant poetics. The work plays with the process of re-contextualization as a brainstorming tool for combinations of common objects that can be profound or illogical, realizable or feats of fantasy.

Creativity and Computation

Symphonic and computational thinking are two metaphors for new strategic frameworks for computer science education.[3,9,10] Computational thinking in computer science is viewed as a foundation for problem solving, system design, and understanding human behavior the spans across technology, creativity, social and natural science disciplines. Computational thinking is: about conceptualization and not programming; a fundamental skill with impact beyond mechanical routines; describes methods people use to solve problems; complements and combines mathematical and engineering thinking; focuses on ideas rather than artifacts; is integral to human endeavors; is intellectually challenging limited only by our own ability to be curious and creative.[10] I would argue that the seven properties of computational thinking are also core to creative digital media practices and exemplified in the works exhibited in Speculative Data and the Creative Imaginary. "Symphonic thinking ...is the capacity to synthesize rather than to analyze; to see relationships between seemingly unrelated fields; to detect broad patterns rather than to deliver specific answers; and to invent something new by combining elements nobody else thought to pair."[3, 9] When the engineer becomes conductor they understand when it is appropriate for one tool or instrument to crescendo to the foreground as the others recede to diminuendo. They understand the appropriateness and impact of one method of expression, inquiry or discovery over another, and how to merge, or layer their palette of expressive ideas and discoveries for the greatest audience or user impact.

If there is one thing common to all of the participants in this exhibition, it is their sophisticated abilities to integrate computational and symphonic thinking. Sheldon Brown's (University of California at San Diego, USA) The Scalable City extrapolates the cultural conditions arising from urban design. It is an "aesthetic gesture....[that] embodies the tension between exuberance and foreboding. Neither embracing nor rejecting an algorithmic world view [the Scalable City inspires] cautionary expressivity driven by its own internal algorithmic logics". Tiffany Holmes' (School of the Art Institute of Chicago), in collaboration with the National Center of Supercomputing Applications has created 7000 Oaks and Counting, a dynamic screen interface designed to bring awareness to occupants of the NCSA building about their carbon dioxide footprints based on their daily activities. Greg Judelman (Bruce Mau Design, Canada) and Maria Lantin's Ph.D. (Emily Carr Institute of Art and Design, Canada) projects FlowerGarden and Aurora are visualizations, one interactive and the other a digital image that illustrate the frequency and relationships between topics of discussion at the Banff New Media Institute. George Legrady's (University of California at Santa Barbara) Global Collaborative Visual Mapping presents a method of categorizing, tagging and presenting digital cell phone images on large screen displays. In this work, Legrady asks the questions: Will cell phone technology transform how we create/use images produced "on the fly"? In what ways do online visual databanks such as Flickr recontextualize the images we create and share? And, can such online images be used creatively as components in artistic works that explore the construction of visual narratives through the juxtaposition of sequenced images? And finally, Martin Wattenberg's Ph.D. (IBM Watson, USA) "Thinking Machine 4" is an artificial intelligence chess game engine that explores a machine behavior as a constantly changing series of choices with the machines decision paths visually articulated as sweeping colorful trajectories.

The creative digital media works in the Speculative Data and the Creative Imaginary: shared visions between art and technology represent a cross section of transdisciplinary research practices that are forging new paths for developing new technologies, discovering new patterns in information, and finding new ways of seeing, knowing, and doing computer and information sciences and engineering.[8] I invite you to peruse this exhibition catalog that is filled with images and writings by and about the works, practices, research, theories, goals, and methods of the creative practitioners in this exhibition.

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Pamela Jennings Ph.D. is an Assistant Professor at Carnegie Mellon University with a joint appointment in the School of Art and the Human Computer Interaction Institute. Jennings worked as a research interaction designer and web producer at IBM Almaden Research Center for the Advanced Technology and Software Solutions Group and the User System Ergonomics Research Lab. She also worked as a research instructional designer for the Center for Technology in Learning at SRI international. Jennings' art work has been cited in Lisa Farrington's Creating Their Own Image: The History of African-American Women Artists, Oxford University Press and Phyllis Klotman and Janet Cutler's Struggles for Representation: African American Film/Video/New Media Makers, Indiana University Press. Her papers have been published and presented in the 2005 ACM Creativity and Cognition, 2005 Human Computer Interaction Consortium, several Inter-Society for Electronic Arts symposiums since 1997, several ACM Computer Human Interaction workshops, 2003 Interact Conference, and the 1999 European Union I3Net Symposium. Her journal articles have been published in the Leonardo Journal for Art and Science, Convergence: the Journal of Research into New Media Technologies, and the CAA Art Journal. Jennings' internationally recognized digital media arts research policy projects include the New Media Arts | New Funding Models white paper commissioned by the Rockefeller Foundation, and co-writer of the Helsinki Agenda documentation of the 2004 Experts Meeting on International New Media Arts Policy sponsored by the International Federation of Arts Councils and Culture Agencies (IFACCA). She co-chaired the 2006 ACM CHI conference workshop titled About Face: Interface – Creative Engagement in New Media Arts and Human Computer Interaction and the first Interactive Art track for the 2004 ACM Multimedia Conference. Jennings received her Ph.D. from the School of Computer Science, University of Plymouth, United Kingdom. in the Center for Advanced Inquiry in Integrative Arts program; M.F.A. from the School of Visual Arts; M.A. from the International Center of Photography and New York University; and B.A. from Oberlin College. pljenn@gmail.com

exhibited works

Nell Breyer

i:move* Variations on a series (2003 – 2007)

"... celebrates the personal and collective movements of each day by incorporating video stream processing, and live interaction to visualize dynamic patterns over a 24-hour cycle."

The basic principle articulated by William H. Whyte's early recordings of public spaces, still holds. Whyte observed that, in public urban spaces, "people looking at other people" is the primary activity – lovers enjoy "standing on the busiest corners", friends have "travelling conversations" and people may simply talk to themselves.[1]

Today's advanced machine vision systems generate unparalleled quality, speed and graphic realism in the capture and analysis of dynamic visual data. By re-thinking the deployment of these technologies, Breyer aims to enable participants and viewers, in everyday public spaces, to observe the characteristics and routine cycles of pedestrian movement. These recorded and analyzed patterns of motion reveal dynamic histories of presence that are presented through live and prerecorded video layers.

i:move is a performance / installation series that explores how we perceive movement. The project celebrates the personal and collective movements of each day by incorporating video stream processing into live interaction to visualize dynamic patterns over a 24-hour cycle. The series has been developed for public spaces that are "bottle necks" of human traffic; including, the IM Pei archway at Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts where continuous motion trails occur like reliable, unpredictable weather patterns: skateboarders share the pathway with professors, students & tourists as they dance complex paths of avoidance and collision. i:move captures coincidences and irregularities of pedestrian behavior, transforming them into two-dimensional shadow plays, that emphasize repetitive rhythms and rituals of daily activities. The results are presented as interactive video projections, processed with text and live video layers presenting a dynamic visual etching of the ebb & flow of movement through public space.

i:move* is a stream processing system software that considers human movements over multiple time scales, perspectives, and magnifications to generate a concise, powerful, and efficient expression of time-oriented computing. Activity in the space is captured, processed and presented dynamically using video camera. Video layering gives a "time axis" for seeing the space as a visual record of motion. Video processing is used to enhance contrast, reveal coincidences. Interactive video is used to engage viewers in playful experimentation.

*** i:move was first presented by Nell Breyer with Kristin Ing at the Boston Cyberarts Festival in 2003. The i:move series software and video materials were further developed in collaboration with Jonathan Bachrach for the MIT Media Lab (2003) and with Fico Balet (Slovenia) for Dance Theater Workshop Gallery (2004). Additional collaborators include Aleksandar Zlateski (MIT).**

1. Whyte, W.H., The Social Life of Small Urban Spaces. 1980, Washington D. C.: The Conservation Foundation.

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i – iv Stills from high definition visual analysis of flow in time and space produced for cable television in Philadelphia.

Nell Breyer is a Research Affiliate at Massachusetts Institute of Technology's Center for Advanced Visual Studies. Nell was an ARM Fellow at Dance Theater Workshop 2003-2004. Breyer's work, supported by numerous grants and fellowships, has been presented internationally and in the United States. Breyer has produced several commissioned public artworks for the World Financial Center Arts and Events program (2005); Harvard Square's LumenEclipse art kiosk (2006); and the Boston City Hall (2004). Her work has been shown at the Museum of Contemporary Art in Rovereto and Trento, Italy (2006); Dance Theater Workshop gallery in New York City (2004); Boston CyberArts Festival (2003); MIT Museum Inventor's Spotlight (2003); group shows at Ethan Cohen Fine Arts and NURTUREart Gallery in New York. Breyer has choreographed and performed in several venues in New York City (The Joyce Soho; Judson Church, St. Mark's; and the Williamsburg Art Nexus); Canada (Espace duMaurier Arts danse MAI); the UK (the Edinburgh Fringe Festival, Sadlers Well's Peacocke Theatre, Her Majesty's Haymarket Theatre; The Place Theatre, Jackson's Lane); Bangladesh (The Bangladesh National Museum Auditorium, The Liberation War Museum); and Slovenia (Cankarajev Dom, TRNFEST). Breyer's work has been supported by the LEF New England General Grant (2004); the MIT Council for the Arts, Dance Theater Workshop and the Center for Advanced Visual Studies at MIT (2003); DanceWeb Scholarship (2002); Sadlers Wells' Courtney & Jake Ulrich Award for new media in performance (1998). She was nominated to receive an EEC Kaleidoscope Grant to create work for il Teatro di Barcelona & Le 1ere Plateforme Internationale de Danse & Baignolet Festival (1997/98). Nell received the John Boit Morse Memorial Traveling Fellowship to support study of the Taruna Jaya dance form in Bali, Indonesia (1993). Breyer received her BA in Art & Humanities at Yale University, 1994; MsC in Cognitive Neuroscience from Oxford University, 1997 , and MS in Media Arts & Sciences from the Massachusetts Institute of Technology, 2002.

Sheldon Brown

The Scalable City (2006 – ongoing)

"... the aesthetic gestures embody the tension between exuberance and foreboding. Neither embracing nor rejecting an algorithmic world view it inspires cautionary expressivity driven by its own internal algorithmic logics."

The Scalable City is a set of projects that extrapolate the cultural condition arising from urban design. It transforms urban design into a choreography of structural repetition that is both mesmerizing and cautionary in its reference to the encroachment of the artificial on nature. In The Scalable City, the aesthetic gestures embody the tension between exuberance and foreboding. Neither embracing nor rejecting an algorithmic world view it inspires cautionary expressivity driven by its own internal algorithmic logics.

Culture has been undergoing a transformation from analog to digital forms and methods for several decades, producing tensions between speculation and anxiety.

As our world becomes increasingly characterized by the equation of use, data and algorithm, we find ourselves inhabiting the artifacts of these relationships. In The Scalable City, a variety of computer concept buzzwords take on choreographic form of generated artifacts and environments. The project is experienced in multiple forms – an interactive game, cinema, installations, animation, and digital prints. This multiplicity of forms creates differing relationships between viewer, artwork and subject. In each area, the temporal and spatial qualities are crafted to suggest bridges in experience. The static image generates spatial interactivity and the game environment cultivates consideration.

The Scalable City artifacts are generated from satellite imagery of Southern California. Height values from the satellite images are sampled and recorded into a height map. Algorithmic processes are applied to the height map and turned into a three-dimensional geometry that is used to generate the road geometry. The road geometry is embedded into the virtual landscape and the surface properties for the three-dimensional images are set. Five major components, Landscape, Roads, Lots, Architecture and Vehicles, are integrated into The Scalable City. Each component is created by a process where real world data is subjected to algorithmic transformations before being redeployed as elements of the urban condition of software I/O. The landscape (a complex natural form) is transformed by a simple algorithmic process; creating a new form which retains naturalism in its details, but with a high level of algorithmically determined decorative elements in its larger scale structure.

Space filling road systems that are located via computer vision analysis are grown into this artifice landscape. The resultant decorative forms are evocative of nouveau iron grates, illuminated texts and oriental space filling spiral patterns. Vehicles, lots and architectural forms follow similar paths of manifestation – each demonstrating the embrace of software as the script of spatial experience. Interactive users control a vortex of flying automobiles. Navigating this vortex through the environment causes the road systems to grow, while detritus is flung into the air and then attempts to self-assemble into ersatz structures.

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i – viii Images from the Scalable City data visualization virtual environment.

Sheldon Brown is Director of the Center for Research in Computing and the Arts (CRCA) at the University of California at San Diego (UCSD) where he is a Professor of Visual Arts and the head of New Media Arts for the California Institute of Telecommunications and Information Technologies (Cal-(IT)2). His work examines the relationships between mediated and physical experiences. This work often exists across a range of public realms. As an artist, he is concerned about overlapping and reconfiguring private and public spaces; how new forms of mediation are proliferating co-existing public realms whose geographies and social organizations become ever more diverse. Art that explores schismatic junctions of these zones – the edges of their coherency – allow glimpses into their formative structures and provide a view that suggests transformative modes of being, extending constrained boundaries. Examples of this include projects such as “In the Event” at the Key arena in Seattle where 9 computers choreograph multiple video streams across 28 monitors in a real time constructive engagement with the spectator’s act of envisioning the events of the arena. In “The Video Wind Chimes” – an outdoor video installation/street lighting project – the culturally encoded part of the electromagnetic spectrum is transformed into the passive illumination of a nocturnal lighting system, articulated by the wind. Projects such as “Smoke and Mirrors” and “Mi Casa es tu Casa”, use the contextual apparatus of museums with adjacent mission scopes to the artworld, for bringing avant-garde strategies to engage ranges of social issues to venues that often use more pedantic forms of discourse. He had done consulting on comprehensive approaches for New Media initiatives with entities such as: the Los Angeles County Museum of Art, PersonaLogic Inc., Praja Inc., The Wonderful World of Oz Inc., LegoLand, Decor Magic, Electronic Arts, Positive Video, and others. Currently, he is developing a series of sculptures, “Istoria”, which explore the intersection of the virtual and physical worlds, created with a variety of computer controlled processes, and several interactive environments that utilize a cross-fertilization of virtual reality and game technologies.

Donna Cox

Visaphors: High-Definition Stereo Visualizations (2005 – 2007)

"Artists and scientists have a common goal – that of making the invisible visible. Many of the images resulting from collaborative scientific visualizations represent a convergence of art and science. These images are yielding some of the most beautiful, and meaningful, imagery of our time."[1]

Donna Cox is the Director of the Advanced Visualization Lab (AVL) at the National Center for Supercomputing Applications (NCSA). The NCSA AVL Lab works closely with computational scientists to employ advanced-technology graphics and novel digital displays, including large-format IMAX film, high-definition television productions, and museum digital domes, to visualize advanced large-scale supercomputing simulations.

Donna Cox's deepest passion is to bring scientific ideas to large, non-expert audiences through the development and aesthetic rendering of Visaphors. These compelling, data-driven com-puter graphics visualizations are inspiring to people and often have "legs" within society. Cox coined the term Visaphor to distinguish data-driven visualizations developed from quantitative data from visualizations that are metaphorically derived. They are models and metaphors used to speculate about invisible patterns and forms in the natural phenomenon by using computer-mediated and digital technologies to display quantitative and qualitative information. Visual variables used to represent quantitative data in the Visaphor greatly influence how we interpret and apply meaning to that data. For example, the initial "meaning" of a Visaphor can be overwhelmed by the captivating visual qualities of the image. However, displaying visuals in immersive environments, such as the VisBox(TM) – a display device for high resolution and immersive three-dimensional graphics applications – can intensify the sensual and information rich experience.

In 1986, Donna Cox formulated the idea of collaborative Renaissance Teams of which the AVL is one that provides a creative research environment to support the realization of Visaphors. It is comprised of an interdisciplinary mix of visualization experts. Robert Patterson is a master choreographer, visualization artist, and musician/composer. Stuart Levy is a senior visualization programmer. Alex Betts has an MFA in graphic design and is a senior visualization programmer. Matthew Hall has a Masters in mathematics and is a visualization programmer. Lorne Leonard has a Masters in Architecture and is a visualization programmer. Visaphors created by the Advanced Visualization Lab, under the creative leadership of Donna Cox, have been viewed by thousands of people in planetariums, Public Broadcasting television programs, school books, science museums and other informal science education and outreach venues. They have had great impact on popular culture's encounter and understanding of science.

High Definition Stereo Three-Dimensional Scientific Visualizations

Six sequences of three-dimensional scientific visualizations displayed in high-definition (1920 × 1080 pixel resolution) stereo using a VisBox™ display system are presented in the exhibition. The system will be driven by donated equipment from Apple including two Xserve RAID arrays with 14 terabytes of disk space. Participants experience the three-dimensional colorful animated Visaphors by wearing stereo glasses. The visualization and simulations viewed in the exhibition described below include phenomenon from F3 Tornados and ocean flow to the astrophysics of supernova and colliding galaxies.

In collaboration with the Monterey Bay Aquarium Research Institute (MBARI), AVL developed Visaphors of ocean flow and temperature. During the AOSN II field experiment, the first large-scale deployment of vehicles was used to predict the evolution of episodic wind-driven upwelling in the environs of Monterey Bay. The observing system included a communication framework that allowed observations to be transmitted to two real-time oceanographic models: HOPS and ROMS. The 3D Visaphors below are the first to reveal these ocean flows in stereo 3D graphics. AVL created each of the visualizations in collaboration with scientists.

• Ocean and Bay Visualization from a Grand field experiment in the Monterey Bay. Scientific simulation: Yi Chao, JPL/Caltech, Regional Ocean Modeling System (ROMS) model, for the AOSN II.

• Ocean and Bay Visualization from a Grand field experiment in the Monterey Bay. Scientific simulation: Allan Robinson, Pierre Lermusiaux, Wayne Leslie, Harvard University, developed and computed the Harvard Ocean Prediction System (HOPS), for the AOSN II

• Visualization of the Anatomy of a Deadly Tornado from the Storm Chaser Perspective. Scientific simulation: Robert Wilhelmson, Matthew Gilmore, UIUC; Lou Wicker, National Severe Storms Lab/ NOAA.

• Visualization of the Evolution of the Universe from 20 million to 14 billion years old. Scientific simulation: Renyue Cen, Jeremiah P. Ostriker, Princeton University.

• A Star is Born, Lives, and Goes Supernova visualization. Scientific simulation: This simulation is an adaptive mesh refinement model developed by Michael Norman, UCSD; Brian O'Shea, LANL.

• The Formation of our Home Milky Way galaxy from 16 million to 13.7 billion years old. Scientific simulation: This simulation is an adaptive mesh refinement model developed by Brian O'Shea, LANL; Michael Norman, UCSD.

• The Explosive Ramifications from Galaxies Colliding and Merging. Scientific simulation: Brant Robertson, University of Chicago; Lars Hernquist, T.J. Cox, Harvard University; Volker Springel, Max-Planck; Tiziana Di Matteo, CMU.

• An Astrophysical Jet forming from a rotating Black Hole. Scientific simulation: John F. Hawley, University of Virginia; Julian H. Krolik, Johns Hopkins University.

• A Virtual Flight to the Center of our Milky Way galaxy. Scientific advisors: Mark Morris, UCLA; Doug Roberts, Northwestern/Adler Planetarium, Chicago.

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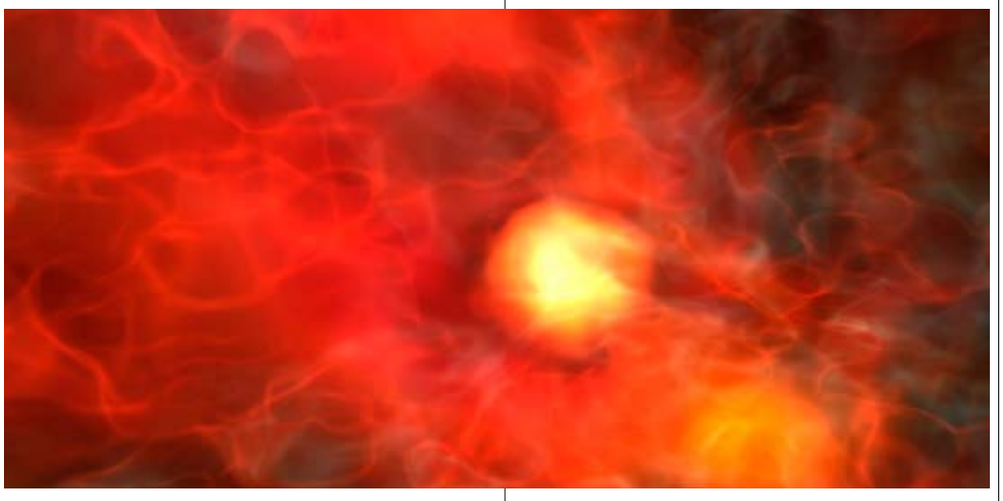

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i Colliding Galaxies
ii A Star is Born
iii Visualizing Evolution

Donna J. Cox is Director of the Advanced Visualization Laboratory at National Center for Supercomputing Applications (NCSA), University of Illinois at Urbana-Champaign (UIUC). She is Professor in the School of Art and Design and a recognized pioneer in computer art and scientific visualization. She received the International Coler-Maxwell Award in for her seminal paper, "Using Supercomputer to Visualize Higher Dimensions: An Artist's Contribution to Science" where she coined the term 'Renaissance Teams.' She was elected SIGGRAPH Director at large for four years and SIGGRAPH 2005 Emerging Technologies Chair and is currently on the Editorial Board of Leonardo: International Journal of Art, Science and Technology. Cox has authored many book chapters and articles including a the recent "Visualization and Visual Metaphors," in Aesthetic Computing, ed. Paul Fishwick, MIT Press, 2006. Cox's collaborations in data-driven visualizations are featured in a variety of large-format venues around the world including digital planetariums. Her greatest passion is to bring science to a wide range of audiences through innovative and aesthetic presentations. She was Art Director and Producer of Scientific Visualization for the science educational IMAX film "Cosmic Voyage," nominated for 1997 Academy Award and funded by National Science Foundation (NSF), Smithsonian Institute, and the Motorola Foundation. She and her team have thrilled millions of people with visualizations for such programs as the Public Broadcasting Service (PBS) NOVA "Hunt for the Supertwister" and "Runaway Universe." Cox and her team worked with the American Museum of Natural History to produce high-resolution visualizations for the Hayden Planetarium's 2000 Millenium show, "Passport to the Universe" and "The Search for Life: Are We Alone?" She is co-PI on the successful Black Holes Project funded by NSF. As part of this project, AVL collaborated with Denver Museum of Nature and Science (DMNS) and Thomas Lucas Productions to create a full digital dome planetarium, "Black Holes: the otherside of infinity." DMNS has the largest digital dome in the United States. This planetarium show premiered in Denver in February 2006, is traveling around the world, and has been translated into three other languages. The other part of the Black Holes Project is a PBS NOVA show entitled "Monster of the Milky Way" and it premiered Halloween 2006. Cox is currently honored at the Chicago Museum of Science and Industry as one of 40 selected modern-day Leonardo DaVinci's,.

Roger Dannenberg

Resound! Fanfares for Trumpet and Computer (2002)

"In spite of all the technology, I believe the real challenge is always to write and perform music that captures the imagination and carries the listener to a new and wonderful place. I hope these little pieces will expand what we think of as "trumpet music" and perhaps open some new pathways for composers, performers, and listeners alike."

Resound! Fanfares for Trumpet and Computer was originally composed for the Pittsburgh New Music Ensemble (PNME) and premiered in the summer of 2002 at the New Hazlett Theater in Pittsburgh, Pennsylvania. The complete composition consists of seven movements, which can be performed individually as fanfares or together as an extended work. Each fanfare expands the solo trumpet into an ensemble using a different technique. To some extent, this is like a canon, where part of the enjoyment is in how the music emerges from interlocking voices. During the premier a different fanfare was performed at the beginning of each concert in PNME season. The complete work is available on Trumpet Voices: Classics for Trumpet Ensemble (Four Winds Label), recorded by Neal Berntsen.

The technical component of Resound! is software written entirely by the composer using a real-time object system named Aura. Aura provides support for communicating objects running in different threads so that expensive operations, such as graphical interface updates, do not interfere with time-critical operations, such as audio processing. All sound processing is carried out in software running under Linux with real-time extensions. Aura has become a test bed for new programming techniques for interactive systems building. In addition to the basic object system, Aura offers a graphical programming interface for dataflow-oriented audio processing and a high-level, real-time scripting language based on Python. In Resound! signal processing is manually synchronized to the human trumpet performance through cues given to a graphical interface. The processing includes time delays, pitch shifting, granular synthesis, ring modulation, looping, overdubbing, and various combinations, although each fanfare in the suite uses only a small subset of these.

McBlare: the Robotic Bagpiper (2004)

In preparing for the 2004 25th Anniversary of the Robotics Institute at Carnegie Mellon University it was suggested that the festivities should include a robotic bagpiper to acknowledge Carnegie Mellon's technical reputation and Scottish heritage. The design team of Roger Dannenberg, Ben Brown and Garth Zeglin set out to build McBlare: the Robotic Bagpiper that could play an ordinary, off-the-shelf traditional set of Highland Bagpipes with computer control. Using a custom air compressor to supply air and electromechanical "fingers" to control the chanter McBlare plays with robotic precision. McBlare is MIDI controlled, allowing for simple interfacing to a keyboard, computer, or hardware sequencer. A computer sends control signals to McBlare to operate the "fingers" to play many traditional bagpipe tunes as well as some recent compositions. McBlare can also add authentic sounding ornaments to simple melodies entered through a piano-like keyboard and play the result on the pipes. McBlare has performed in Miami, Pittsburgh, Vancouver, and in 2006, McBlare traveled to the International Piping Festival in Glasgow. McBlare has also appeared and performed on the Canadian Broadcasting Company and the BBC Scotland.

Resound! Fanfares for Trumpet and Computer and McBlare: the Robotic Bagpiper were performed and exhibited during the exhibition opening and ACM Creativity and Cognition opening on June 13th, 2007)

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i McBlare the Robotic Bagpipe
ii Roger Dannenberg

Roger B. Dannenberg, Ph.D. is an Associate Research Professor in the Schools of Computer Science and Art at Carnegie Mellon University, where he is also a fellow of the Studio for Creative Inquiry. His compositions have been performed by the Pittsburgh New Music Ensemble, the Pittsburgh Symphony, and at festivals such as the Foro de Musica Nueva, Callejon del Ruido, Spring in Havana, and the Conference on World Affairs. Dannenberg is well known for his computer music research, especially in real-time interactive systems. His pioneering work in computer accompaniment led to three patents and the SmartMusic system now used by tens of thousands of music students. He also played a central role in the development of the Piano Tutor, an intelligent, interactive, automated multimedia tutor that enables a student to obtain first-year piano proficiency in less than 20 hours. Dannenberg held a patent for large-scale interactive games controlled by crowd noise, and these “stadium games” have entertained many NFL fans. Other innovations include the application of machine learning to music style classification and the automation of music structure analysis. As a trumpet player, he has performed in concert halls ranging from the historic Apollo Theater in Harlem to the Espace de Projection at IRCAM, and he is active in performing jazz, classical, and new works.

Ernest Edmonds

Shaping Forms series (ongoing)

"... we can consider the artwork and the audience as interacting systems that influence one another. We can consider the development of computational art systems that are open to influence and that develop over time as a consequence. Equally we can think of the influence that such systems will have on their audiences. We therefore need to consider this kind of computational generative art in open systems terms from the very core of their design."

The works shown in the Speculative Data and the Creative Imaginary exhibition come from my Shaping Form series. They are generative visual works whose behaviour and forms are influenced by the activities detected by a camera. The influence is ever growing and developing. Although responses to movement in front of the works can be detected sometimes, the key influence is on the long term nature of the work. These are the latest works developed out of a concern both with interaction and with time that I have worked on for many years through a wide range of abstract generative forms.

Digital art may be static or dynamic with a totally fixed behaviour but often such artworks, or art systems, interact with the world in some way. These interactions may be with objects that, for example, an art robot bumps into or may be with an audience sensed through image or sound analysis. The most complex interactions are potentially those with the audience, with purposeful enquiring (human) systems. Whilst a concern for interaction in computational art has been with us for a long time, and I first wrote about it with Stroud Cornock in 1970 [1], it still deserves careful consideration. What is the nature of such interaction and what is the range of forms that it might take? How might those forms determine the kind of computational mechanisms that are appropriate for the artwork?

Burnham argued for the importance of understanding artworks in their environmental context and that all things 'which processes art data,...are components of the work of art'[1]. So by that definition, the audience is part of the artwork. As early as 1966, Roy Ascott had developed a theoretical position in which participation and interaction between the audience and the artwork were central. [3] He later gave up the practice of making art objects all together: 'In California in the 1970s, introduced to the computer conferencing system of Jacques Vallée, Informedia, I saw at once its potential as a medium for art and in 1979 abandoned painting entirely in order to devote myself wholly and exclusively to exploring telematics as a medium for art'. [2] In other art forms, such as Happenings, participation was also prevalent. Kirby described rather basic examples of participation in Allan Kaprow's Eat thus, 'Directly in front of the entrance, apples hung on rough strings from the ceiling. If the visitor wished, he could remove one of the apples and eat it or, if he was not very hungry, merely take a bite from it and leave it dangling'. [2]

Participation in the artwork by becoming part of the art system and interacting with whatever the artist provided has now become a familiar experience. But what exactly do we mean by interaction? In some respects, with delayed response, as a result of mode change, and even delayed influence on autonomous output in the same way, interaction does not seem an appropriate word to use. Perhaps the words influence, stimulus, interchange are more evocative of this meaning. Perhaps the influence of one system on another could be said to come about as a result of stimulus, interchange or even co-operation and conversation, if we add a layer of meaning to the situation. We may talk about the audience's influence on an art system where the development of its behaviour is affected by the interactions that it has experienced.

Thinking in these terms, we can consider the artwork and the audience as interacting systems that influence one another. We can consider the development of computational art systems that are open to influence and that develop over time as a consequence. Equally we can think of the influence that such systems will have on their audiences. We therefore need to consider this kind of computational generative art in open systems terms from the very core of their design.

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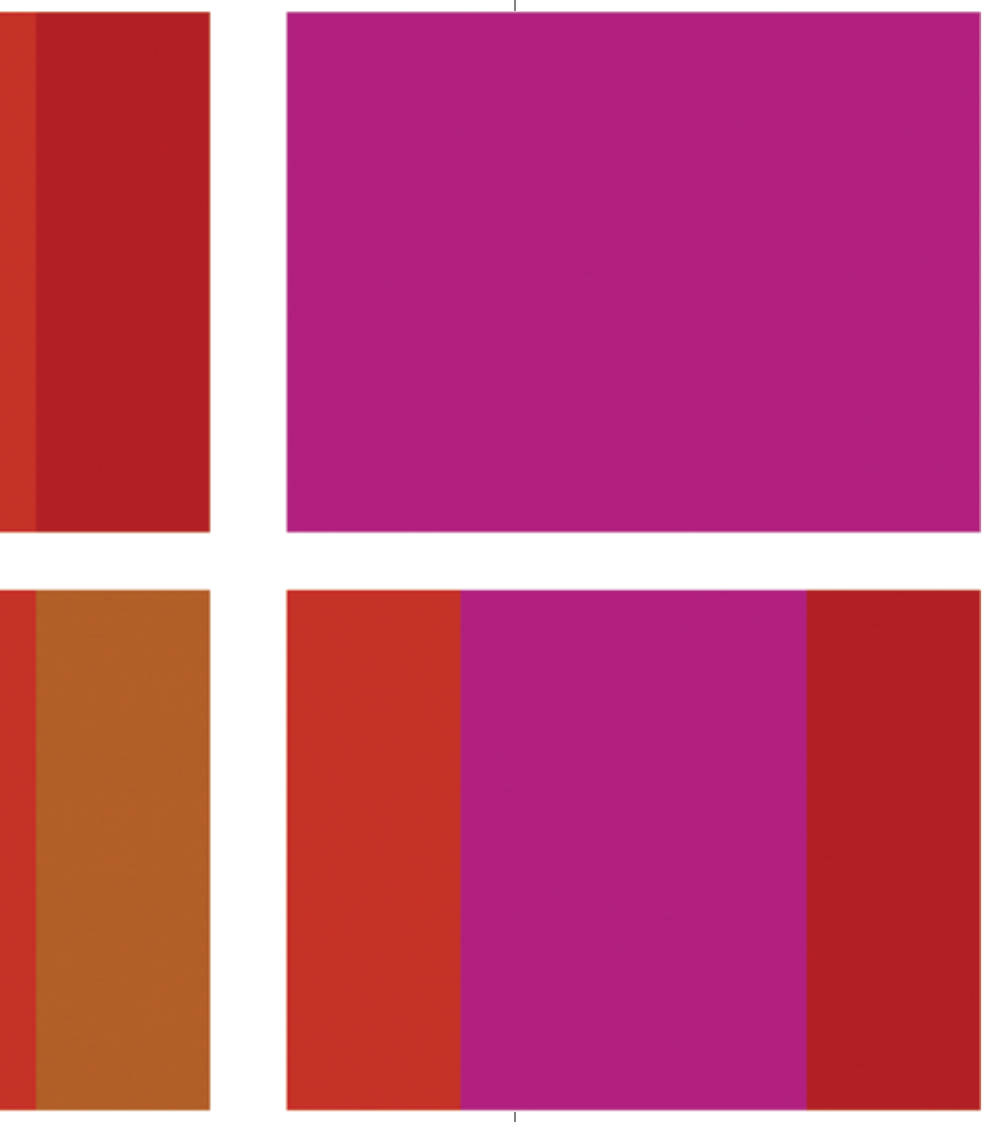

Ernest Edmonds works in the constructivist tradition and first used computers in his art practice in 1968. His work is concerned with color and minimal forms, particularly in the context of time and interaction. He first exhibited an interactive work with Stroud Cornock in 1970 and first showed a generative 'video construct' in London in 1985. He has exhibited throughout the world, from Moscow to LA. Artists Bookworks recently published his book "On New Constructs in Art". He is Editor-in-Chief of the Leonardo Journal's Transactions, which publishes original reports on new practice and developments in art and technology. In April, he gave an invited performance with Mark Fell, at the Corcoran's Armand Hammer Auditorium, of one of their abstract audio-visual pieces. This was part of the "ColorField Remix" celebration of the Washington Color School of painters.

Ernest Edmonds was a pioneer in the development of a practice-based research approach to digital art. He is also Professor of Computation and Creative Media at the University of Technology, Sydney Australia, where he leads a multi-disciplinary digital art research studio. He is represented by the Conny Dietzschold Gallery, Sydney.

Acknowledgements

Shigeki Amitani provided technical assistance in the construction of the Shaping Form works shown in the exhibition. The Australasian CRC for Interaction Design supported Ernest Edmonds in his participation in the exhibition.

Tiffany Holmes

7000 Oaks and Counting (2007)

"We leave a unique mark – a visual trace, a biological residue, or a data packet – in the spaces that we use daily. It is my goal as an artist to use information as material and content to increase public knowledge and awareness of hidden data."

Holmes' art explores the intersection between artistic and scientific modes of information representation. Holmes' creative practice is focused on using art and writing to educate and inform the public about the conservation of ecological resources. She accomplishes this goal through several diverse practices and activities that include her blog web site http://www.ecoviz.org/ that profiles the work of artists and designers who are using dynamic environmental information to promote ecological stewardship.

Buildings breathe data. Our homes shelter technology that quietly counts in the background of our daily lives. We cook; we wash; we sleep. All the while, small electronic gadgets tally numbers that remain either inaccessible, or beyond our ability to interpret. For example, residential water meters are often hidden in dark basements. How many of us know how many gallons of hot water we use daily? As a media artist, Holmes is defining a new art form she calls eco-visualization. Eco-visualization involves the development of dynamic data-rich interactive interfaces that expose people to the potential implications of invisible and hidden ecological phenomenon and resource usage patterns.

Holmes' project has been developed in collaboration with the National Center for Supercomputing Applications (NCSA) and is to be installed in their Illinois building. The ultimate goal of the public artwork is for the National Center for Supercomputing Applications (NCSA) building to become carbon neutral.

The title, 7000 Oaks and Counting, is homage to artist Joseph Beuys' 7000 Eichen (7000 Oaks, 1982). Beuy's installation involved the planting of 7000 oak trees to promote awareness of deforestation in Germany. Trees are the defining metaphor for the piece for multiple reasons. Perhaps least significant, the oak tree is the state tree of Illinois and the national tree of the United States of America. Most importantly, however, trees are public symbols of carbon sinks. The concept of carbon sinks is based on the natural ability of trees, other plants and the soil to soak up carbon dioxide and safely store the carbon in wood, roots, leaves and the soil though photosynthesis.

7000 oaks and counting will provide many levels of information that highlight "differences that make a difference." In reality actions such as turning off lights and coffeepots and biking to work can do more in the long run for our climate than planting actual trees. The public art piece offers building residents the opportunity to combat carbon loads through self-defined offsets. Offsetting occurs when someone pays someone else to reduce emissions of carbon dioxide on his or her behalf usually by planting trees or agreeing to wash clothing only in cold water.

7000 Oaks and Counting is composed of a sequence of animated clips using a series of tree images that correspond to the carbon loads in the building; though it takes some time to virtually "plant" or visualize 5600 trees. Occupants in the NCSA building are invited to make individual public commitments to reduce their own carbon footprint through a web form. After filling out a web form, the individual's name is incorporated into the animation sequence and the carbon offset is applied immediately to the building's total. One of the key issues in visualizing energy consumption data is the sheer scale of the numbers. A fairly average load for a large university building in the winter is 800 pounds of carbon added to the atmosphere by 5pm. To offset this amount via reforestation, 5600 trees must be planted. Trees are considerably easier to picture as opposed to 533-kilowatt hours. The animation brings a little of the outdoors inside: most individuals maintain positive feelings toward trees, particularly species that are familiar to them. If the building residents obtain this goal, the animation shows waves of concentric circles emanating from a central core as a metaphor for the holistic cooperation and collaboration by the building occupants.

The public art piece for NCSA has been made possible through the efforts of several persons. Keith Erickson, from the University of Illinois campus facilities management, has led the effort to interface between the artist and the utilities crews at NCSA; Nick Buraglio, an NCSA network engineer, provided technical support; and Michael Murray, from Lucid Design Group, consulted for the project.

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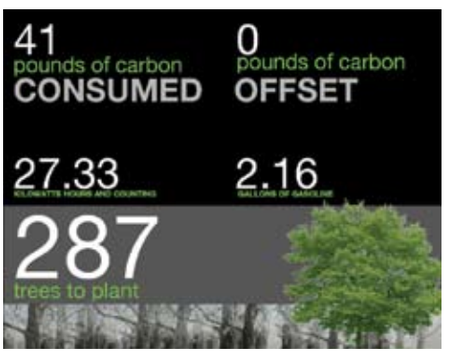

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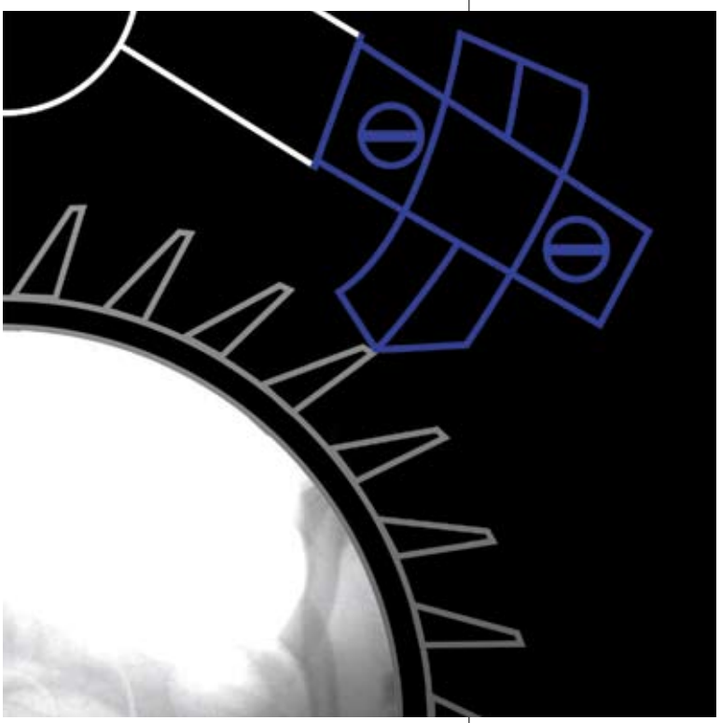
i 7000 oaks and counting; carbon neutral state achieved.
ii 7000 oaks and counting; low carbon loads.
iii & iv Increasing loads result in more “trees” to plant virtually.
v As carbon loads rise the sky turns a warning red.

Tiffany Holmes is Associate Professor, and Chair of the Department of Art and Technology at the School of the Art Institute of Chicago where she teaches courses in interactivity and the history and theory of electronic media. Holmes’ installation work explores the potential of technology to promote positive environmental stewardship. She lectures and exhibits worldwide in these venues: J. Paul Getty Museum in Los Angeles, Digital Salon ’99 in New York City, Viper in Switzerland, Next 1.0 in Sweden, SIGGRAPH 2000, World@rt in Denmark, Interaction ’01 in Japan, ISEA Nagoya. She is a recipient of the Michigan Society of Fellows research fellowship in 1998 and has received grants from the Illinois Arts Council and the Artists-in-Labs residency program in Switzerland.



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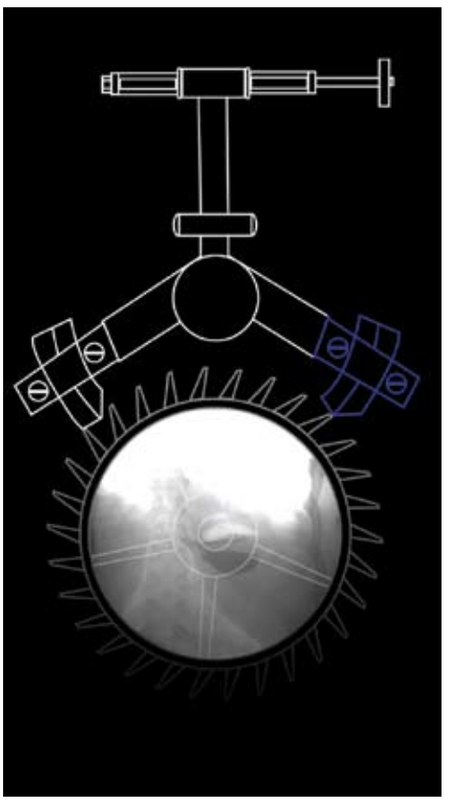
Sui Generis (2005 to ongoing)

In our increasingly mediated environment, marked by pervasive and ubiquitous computing and wireless devices, practices in digital media culture are no longer limited to screen-based, audiovisual and interactive media content. These practices address the wider social, urban and global context of the information environment, through new types of process-based, networked projects and genres.

Jennings' digital media art works make visible personal narratives by revealing hidden realities while simultaneously encouraging public discourse. In particular, her research in critical creative technologies is informed by a convergence of critical theories of technology, human centered computing, and contemporary practices in interaction design and digital media art. Resulting in the development of new information technologies and collaborative applications for facilitating face-to-face discourse in public spaces with others in situations where communication may be stifled by societal norms.

Approaching the development of a theory, model and framework for critical creative technology from a hybrid arts / human computer interaction perspectives permits her to employ the process of making as part of the process of theorizing. In other words, the arts perspective permits the researcher to explore and develop before settling on generalized principles to form a framework for practice. Whereas a more traditional approach to research, narrows the field of inquiry so that general principles can be identified. This process requires the elimination of confounding variables. However, that noise in the data, those confounding variables provide the rich context, media, and processes by which creative practices thrive. As research in the arts gains recognition for its contributions of new knowledge, the traditional reductive practice in search of generalized principles will be respectfully joined by methodologies for defining "living" principles. These "living" principles celebrate and build from the confounding variables, the data noise, through the lenses of serendipitous discoveries, playful encounters and revealing ambiguities.

The theory of critical creative technology examines the relationships between critical theories of technology, society and aesthetics, information technologies and contemporary practices in interaction design and creative digital media. The theory of critical creative technology is aligned with theories and practices in social navigation and community-based interactive systems in the development of "smart" appliances and network systems that support people in engaging in social activities, promoting communication and enhancing the potential for learning in a community-based environment. The theory of critical creative technology amends these community-based and collaborative design theories by emphasizing methods to augment and enhance face-to-face dialogical contact when the exchange of ideas, observations, dreams, concerns, and celebrations may be silenced by societal norms about how to engage of others in public spaces. This comparative theoretical study informs the design of technology-based projects, in the spirit of critical creative technologies, as forms of research-in-practice that incorporates the digital media arts, interaction design, critical theory, human computer interaction and engineering. Sui Generis is a series of large digital print self portraits that explore the relations and contestations between the body and sciences of the artificial. They are thought pieces leading to the development of mechatronic interactive sculptures that fall under Jennings' aesthetic engineering projects that range from self-situated expression to community-based applications. These self-portraits locate the body as a fanciful machine with hints of technological tropes that suggest a relational functionality to technology. The



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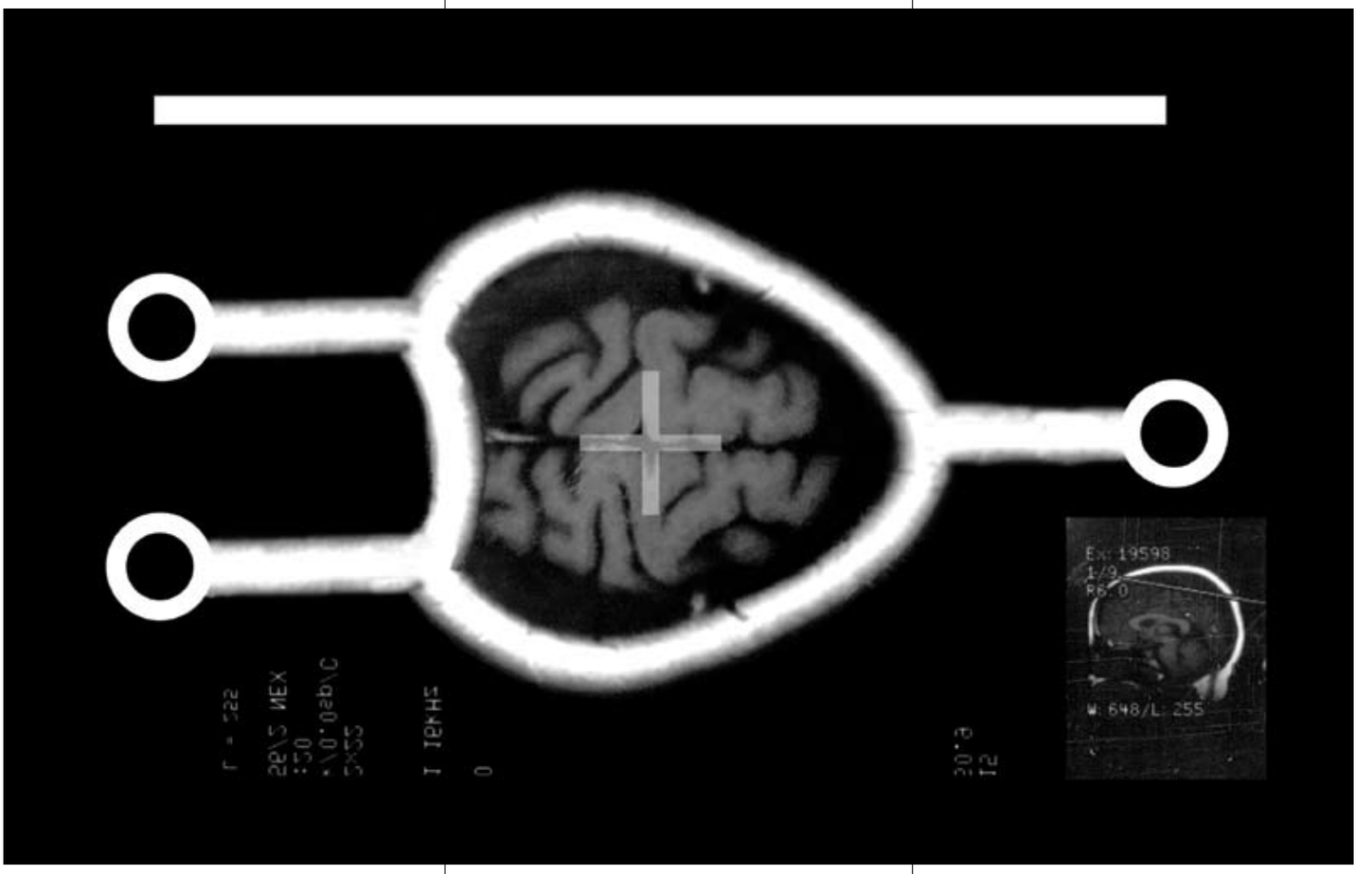
Sui Generis series includes the images Swallow (50 × 90 inches 2005), Corpus Escapement (73 × 50 inches, 2005) and Neither|Nor (36 × 44 inches, 2006). The latter two are presented in this exhibition. Neither|Nor references the fact that she was born with a concave surface in the back of her mind. Like Winterson's webbed feet, she celebrates eccentricity by molding the fatty layer of her cranium to reflect her boolean likeness, the NOR symbol. Inspired by the idiom "neither fish nor fowl," she reveals the complexity of what she may or may not be. Corpus Escapement references her fascination with mechanical devices designed for navigation, time keeping and computation. In particular, her interests are focused on early mechanical computational devices such as astrolabes, gear clocks,



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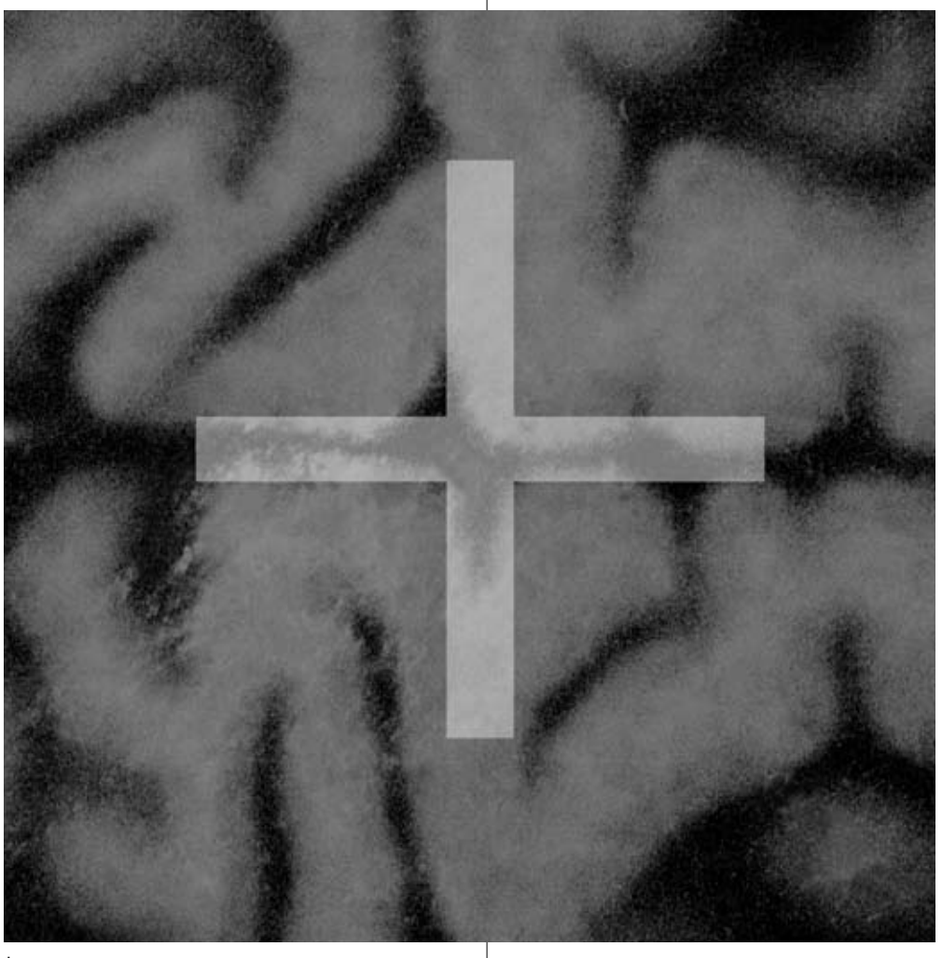

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lantern projectors, and Babbage's Difference Engine. It is the innovation of these types of devices that enabled societies to explore, conquer, pillage and enslave new worlds by controlling the navigation of time, space and territory. She is interested in the ironic juxtaposition and comparison of these types of devices to the body that is both intact and altered – the next frontier.

i Corpus Escapement – detail, digital print
ii Corpus Escapement, archival digital print, (73 × 50 inches)
iii Neither | Nor, digital print, (36 × 44 inches)
iv Neither | Nor, detail, archival digital print

Pamela Jennings' Ph. D biography is printed on page 8.

Greg Judelman & Maria Lantin

flowerGarden (2005)

Visualizing social networking and discussion in a small community

Inspired by Gustav Klimt's painting "Flowergarden" (1905) the flowerGarden is an interactive visualization of social networking and concept sharing occurring within a small group of thirty to eighty individuals.

flowerGarden was deployed at the Bodies in Play Summit, a conference held at the Banff New Media Institute (BNMI) in May of 2005. Set up as a projected installation in the event space, participants entered information about the conversations and topics of discussion they had with others. Over the course of the event, the flowerGarden grew from a few sparse flowers to a lush garden as the number of participants (flowers) and conversations (flower petals) increased.

The Flash web application allows participants to input conversation information (grow mode) or navigate data (explore mode), visualized as an overlapping combination of a social network graph and a word cloud concept map. Each participant is represented as a flower with their initials in the centre and one petal for each conversation they have entered. A vine links participants who have had conversations. The frequency of concept entries is mapped to word size and position, showing commonly used terms in the center of the circle. For the purposes of the Speculative Data and the Creative Imaginary exhibition, grow mode has been disabled but visitors can explore the garden grown by participants at the original conference in 2005.

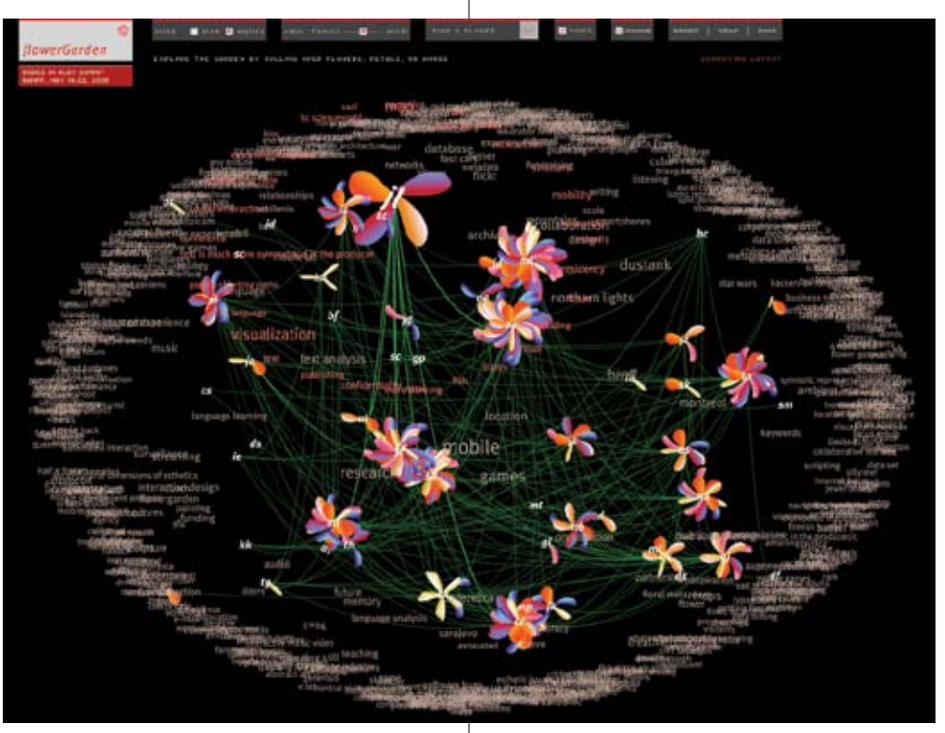
FlowerGarden was made in collaboration with programming support from David Kretz and funding support from the Social Sciences and Humanities Research Council of Canada and the Banff New Media Institute.

Aurora (2004)

Visualizing the evolution of ten years of new media discourse at the Banff New Media Institute

Inspired by the ebb and flow dance of the Northern Lights that frequent the skies above the Banff Centre in Canada's Rocky Mountains, this image is a visualization of the evolution of the Banff New Media Institute (BNMI) discourse over the last decade.

Word frequency statistics were generated using text analysis software that analyzed the corpus of texts in BNMI's 1993-2004 archives (websites, summit agendas, press releases, etc.). These frequencies were mapped both to word size and glow intensity. Large words with a bright glow behind were important topics in the discourse in that year, while small words with a dark sky behind were less significant. Read the columns vertically to discover the popular topics for a particular year, read the rows horizontally to discover the evolution of particular topics over time. This visualization was designed in collaboration with Matthew Sloly, word frequency data by Andrew Salway (University of Surrey), and photography by Don Lee.



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i flowerGarden, social network and conversation visualization software
ii Aurora, printed visualization of text analysis of new media discourse over 10 years

Greg Judelman is a designer at Bruce Mau Design in Toronto, exploring creative process as agent of positive social transformation. His prior research examined visualization and interface design as a strategy to reveal the organic simplicity inherent in informational complexity. He has worked as an interaction designer and media arts researcher including time with the Canadian Broadcasting Corporation and Canada's Banff New Media Institute. His M.Sc. thesis Knowledge Visualization, completed in 2004 at Germany's International School of New Media, focused on the development of interaction design and visualization strategies for the communication of knowledge.

Maria Lantin, Ph.D. is currently Director of the Intersections Digital Studios at the Emily Carr Insitute of Art + Design. She has worked with computer graphics and visualization beginning with her doctorate degree in computing science, awarded in 1999 from Simon Fraser University. Her path as a computer scientist curved into the art world when she began to experiment with clay, taking classes at Emily Carr Institute. With a newfound awareness that so much was possible by combining the knowledge contained in the artistic and scientific fields, she began to actively seek opportunities in that intersection. She spent 3 years as head of the Visualization Laboratory at The Banff Centre where she collaborated with many artists through the co-production and workstudy programs, spanning fields from virtual reality, visualization, and simulation. She continues her explorations at Emily Carr Institute, through collaborative and individual work in visualization and mixed realities.

George Legrady

Global Collaborative Visual Mapping Archive II (ongoing)

"Will cell phone technology transform how we create/use images produced "on the fly"? In what ways do online visual databanks such as Flickr recontextualize the images we create and share? Can such online images be used creatively as components in artistic works that explore the construction of visual narratives through the juxtaposition of sequenced images? What may be relevant use of voice annotation to add metadata to images?"

Global Collaborative Visual Mapping Archive (GCVMA) consists of a dynamically growing archive of cell phone transmitted images with metadata contributed by participants from anywhere within the reach of cellular transmission and reception in the world. The project highlights individual to community participation through cell phone transmission technology. The community of participants interacts with a visual archive of images without spatial-geographical boundaries, submitting their own contributions and annotating others, anywhere from the private space of their living room to the public space of Times Square in New York City. The received images are visualized within a virtual 3D architectural structure, their organization based on a number of metadata criteria such as cell phone numbers, location, service providers, time and date of transmission, and categories and descriptive tags contributed by participants.

GCVMA premiered at the International Society of Electronic Arts (ISEA) 2006 San Jose, California juried exhibition and conference in July 2006. At ISEA, the installation consisted of a 12 foot cinematic projection.

The version of this project for the Speculative Data and the Creative Imaginary exhibition at the National Academy of Sciences implements voice annotation that enables participants to rate images with metadata information. That in-formation is used to cull images from Flickr, the popular online digital photo archive web site, to juxtapose images contributed through cell phone transmission.

Contributors to this project include, George Legrady, concept, aesthetics, and project management;Angus Forbes, systems engineer & visualization; and Mark Daggett, social software engineer, web services & application programming.

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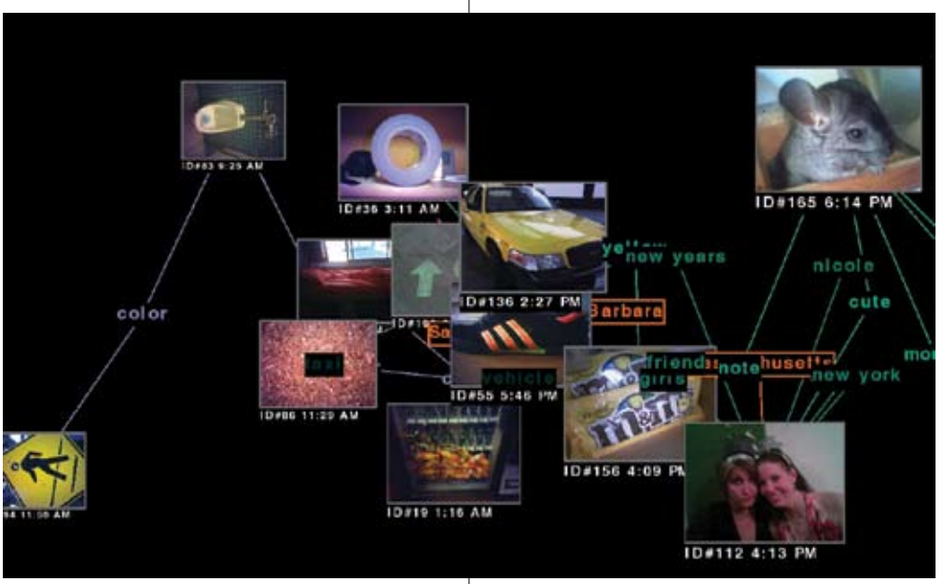

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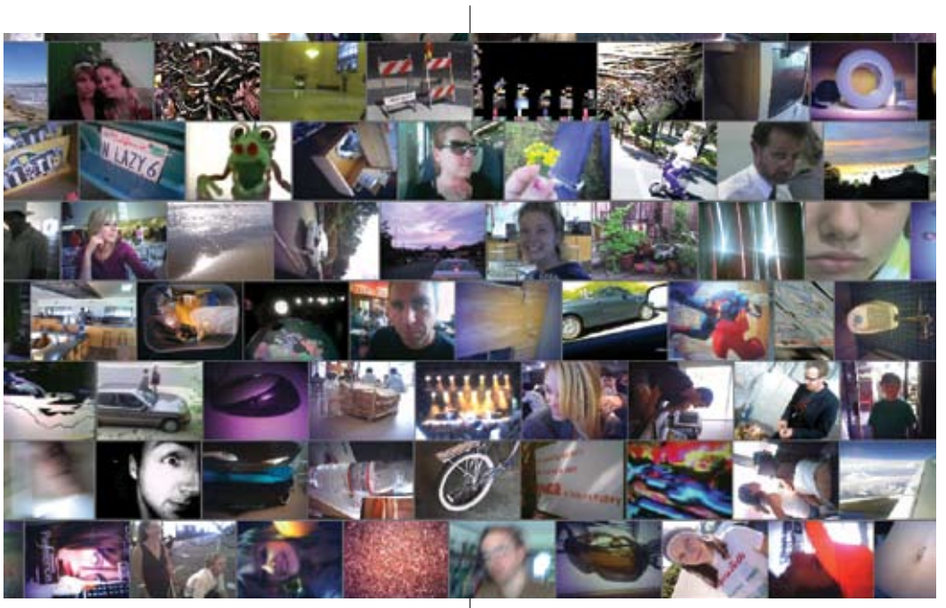

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i Cumulative view of area codes, image categories, and metadata tags in the GCVMA
ii Network Flow View of images in the GCVMA
iii Cumulative view of images in the GCVMA

George Legrady is Professor of Interactive Media, with joint appointment in the Media Arts & Technology program and the Department of Art at the University of California, Santa Barbara. He has previously held fulltime appointments at the Merz Akademie, Institute for Visual Communication, Stuttgart, the Conceptual Design/Information Arts program, San Francisco State University, University of Southern California, and the University of Western Ontario. Legrady received the Masters of Fine Arts degree from the San Francisco Art Institute. Legrady has received awards for creative work from the Creative Capital Foundation, (2005, 2003, 2002); the Daniel Langlois Foundation for the Arts, Science and Technology, Montreal (2000); Computer Integrated Media Awards from the Canada Council (1997, 1996, 1992); an Artslink, NEA grant, (1996); a National Endowment for the Arts Visual Fellowship (1995); first prize in the "New Voices, New Visions" international competition, Voyager and Interval Research Corp. (1994); honorable mentions for interactive media at Ars Electronica, Linz, Austria (1994, 1988); numerous Canada Council and Ontario Arts Council grants from 1975 to 1990. Recent interactive installation exhibitions have taken place at the 3rd Beijing Media Festival, (2006); the BlackBox Invitational, ARCO Art Fair, Madrid (2006); Telic Gallery, Los Angeles (2006); Cornerhouse, Manchester (2005); Philbrook Museum of Art, Tulsa (2004); Museum of Contemporary Art, Helsinki (2004); Ars Electronica Festival, Linz, 2003; DEAF 03, Rotterdam, 2003; the ISEA Conference in Nagoya, Japan, [Sensing Speaking Space] and the San Francisco Museum of Modern Art, 2002; the Centre Pompidou, Paris [Pockets Full of Memories], 2001; [Transitional Spaces] the Rotunde at the Siemens World Headquarters in Munich, [Transitional Spaces], 1999-2000; the Museum of Contemporary Art, Los Angeles, [Tracing], 1998; the Kunst und AustellungHalle der Bundes Republik in Bonn, [Tracing], 1997-1998; the National Gallery of Canada and the Canadian Museum of Contemporary Photography, 1997-1998; the Palais des beaux-arts, Brussels, [An Anecdoted archive from the cold War], fall 1997. [Slippery Traces] was presented in the Siemens curated "Deep Storage" exhibition at the Haus der Kunst, Munich, 1997; the Kunstforum, Berlin, Fall 1997; the kunstmuseum, Dusseldorf, Spring 1998; Projects Studios One, New York, summer 1998, and the Henry Art Gallery, Seattle, Fall 1998.

Angus Forbes is a PhD student and IGERT fellow in the Media Arts & Technology program at University of California, Santa Barbara. His research areas include information visualization, interface design, self-organizing algortihms, and computational linguistics. His artwork was recently shown at ISEA'06 in San Jose and at the Pari Nadimi gallery in Toronto. In 2006 he created the interface to the National Geospatial Digital Archive, a multi-campus preservation initiative funded by the Library of Congress. He founded Synaesthetic Software, Inc. in 2002 to develop music education software. Angus is also the drummer for Heat Death, a Gamelan-influenced heavy metal/noise duo.

Mark Daggett is an artist, designer, and technologist working mainly in the field of social software and networked knowledge. Presently Daggett is a Ph.D .student in the Media Arts and Technology department at the University of California at Santa Barbara. Daggett most recently was the experience design manager for Revver.com and now holds a position as an adjunct Social Software researcher. Before Revver, Daggett, was the Director of Information Architecture for Skechers USA. Artistically, Daggett's work has shown in the Whitney Museum, the Princeton Museum, P.S. 1, the Ars Electronica Festival in Linz, Austria, and the Transmediale festival in Berlin. Daggett has been nominated for several prestigious awards, including a 2006 Rockefeller New Media Grant, and a Webby Award. Major media sources have covered Daggett's work, including the New York Times, Le Monde, WIRED Magazine and Surface Magazine.

Marcos Novak

AlloBrain@AlloSphere Project
(2006 – ongoing)

Marcos Novak's work has long explored the fusion of art, science, and of their modalities of expression into a continuum. His works proceeds along its own adjectival trajectories from liquid architectures, to transarchitectures, to invisible architectures, to transvergence, to his present explorations of the idea of the alien and its own adjectival modifier allo~, suggesting alien architectures or alloarchitectures. Beyond architecture: The encounter with change, especially rapid, technologically driven change of the kind that fractures conceptions and definitions, has become constant, pervasive and relentless. It extends far beyond architecture to encompass all aspects of culture. In his writings he has proposed that this change is sufficiently widespread and deep to warrant naming this period of culture transmodernity, stating that ours is a global transmodern culture directed towards the condition of virtuality, in both a technological and a philosophical sense. Transmodernity, he argues, is characterized by the extensive and deliberate production of an extreme form of the other, for which he has appropriated the term alien, derived from the Greek root allos. The choice of this word focuses attention on the cultural production of the alien as a philosophical and critical notion, useful in shedding light on the global investment of interest, effort and resources to diverse projects such as human cloning, transgenic art, and the Mars mission and beyond, but also calling attention to alienation as a corollary of globalization. Conjoined with the prefix trans~, which he uses to direct attention to the combination of incessant intellectual restlessness and conceptual mobility that characterizes our current epistemological attitudes, bent as these combined aspects are on breaking not only all taxonomic barriers but even emerging and future ones, the alien and its production form an alchemical and kaleidoscopic perpetual-motion machine, one whose epoch-altering output is endless allogenetic transvergence.

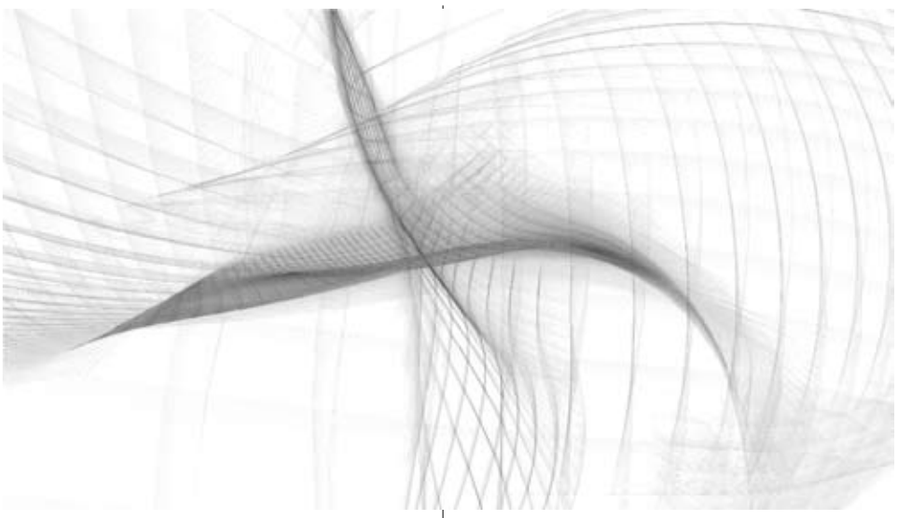
Marcos Novak's ongoing AlloBrain@AlloSphere project investigates the neurophysiological basis of aesthetic appreciation while at the same time seeking to merge scientific research with avant-garde artistic production of new "transvergent" forms of expression Novak's premise is that the notion of "beauty" has been a persistently important aspect of human life across all cultures through the ages, but is as misunderstood now as concepts such as "chaos" were until not so long ago. Defining "beauty" has been deemed too difficult to consider due to its many subjective components. The fact that most people will report that something (if not necessarily the same thing) is beautiful indicates that there is an objective basis to their assessment. Furthermore, creative people of many kinds (artists and composers, for instance, but also scientists and engineers, and others) not only recognize beauty, but produce it on a regular basis. What is it that these people are doing? What parts of the brain (and "mind" as that which the brain produces) are involved in this, and how? Moreover, what is deemed beautiful has its own objective properties, both formally and structurally, and engenders objective relations with the perceiving mind. Thus, Novak proposes that the report of "beauty" is an objective statement about the relation between two complex and dynamic objects: the artwork and the brain/mind. While what each of us considers beautiful differs, and while our brains/minds also differ, stating that something is beautiful may yet be objective in expressing that a particular resonance has been struck between the perceiver and the perceived. That 'resonance' is 'beauty.'

Of course, there is great variation among people in evaluating attributes of aesthetics. Refusing to be blinded by the relativizing and weak "beauty is in the eye of the beholder" argument, Novak notes that a better approach to the question of beauty may be to study one or few instances as closed systems, learn as much as possible about them, and then see if what has been learned can be generalized to others. As artistic, scientist, and subject, all-in-one, Novak subjects his own physiological body and subjective proclivities of beauty as that closed state in his fMRI brain imaging studies in a feedback loop in which the art affect the brain and the brain generates new data that creates new art, that in turn affects the brain, that generates new data, and so on.

To seed the process, Novak writes generative algorithms that produced stimuli that he can not anticipate in detail, and that trigger in him the reaction of beauty (in terms of visual, spatial, and auditory composition). For this project, the stimuli consisted of either a) an interactive/generative moving/changing image, or b) video recordings of this so that they could be used in the fMRI machine. While in the fMRI machine, he was presented with this video (which was not seen previously). Whenever he felt that the visual compositions were beautiful to him, he pressed a button. The pressing of the button was timed, so that it could be correlated with the activity of the brain at that instant. Additional research with 16- and 128- channel EEG data is adding further detail to the this work. The collected data are then converted to a variety of artifacts, several of which can be seen here. While general conclusions cannot be drawn from a sample of one, Novak holds that studying one sample closely may produce guidelines helpful toward the study of other people. Sometimes studying one mind well is better than studying many minds poorly.

The fMRI and EEG data are converted into an immersive environment, or "world." This step allows two parallel possibilities: from a scientific viewpoint, it permits the structural and functional data to be perceived from within in ways that conventional visualization techniques do not allow. From an artistic and philosophical viewpoint, it proposes a novel art forms in which the brain (and subsequent mind) produces the world, and the world alters the mind, which in turn produces another world, and so on. In both cases, a feedback loop can be constructed in which the user's response itself helps generate the stimuli that trigger that response, thus amplifying the effect.

The Allobrain@Allosphere project has been made in collaboration with the University of California AlloSphere team including Dr. Mark Cohen (UCLA Brain Mapping Center); Dr. JoAnn Kuchera-Morin (UCSB MAT);Dr. Xavier Amatrian (UCSB MAT); and Professor Stephen Pope(UCSB MAT). And UCSB Ph.D. students HyunKyung Ji, Dan Overholt, Lance Putnam, Wesley Smith, John Thompson, and Graham Wakefield. Along with the Transvergence Research Group and the AlloSphere Working Group.



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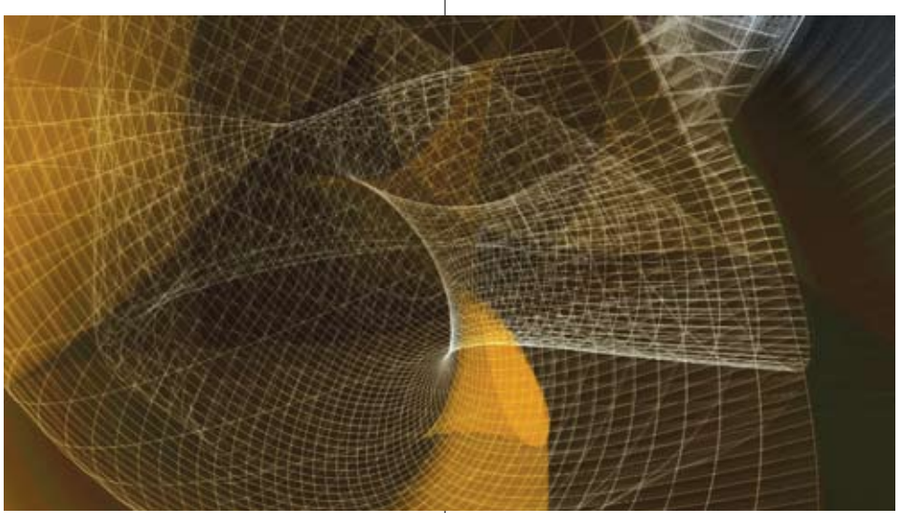

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i – v Virtual landscapes from the Allobrain@Allosphere project.

Marcos Novak is a global nomad, and an artist, theorist, and transarchitect. His theoretical essays and interviews have been translated into more than twenty languages in eighty countries, and he lectures, teaches, and exhibits worldwide. Drawing upon architecture, music, and computation, and introducing numerous additional influences from art, science, and technology, his work intentionally defies categorization. He is a pioneer of the critical consideration of virtual space as place and architecture, and of the use of genetic and generative computation in design. He originated several widely recognized concepts, anticipating many of the developments in virtual, augmented, mixed, and alternative reality research. He has participated in many international exhibitions, including the 7th International Biennale di Venezia, where he represented Greece, and the 9th, where his AlloBio project received prominent attention for its anticipation of the growing influence of the genetic and biomathematical in Architecture.

Sabrina Raaf

Test People Series (2004 – ongoing)

"As an artist, it is extraordinarily exciting to create a work that takes on a life and function of its own – and which can itself create unexpected and unpredictable things."

Sabrina Raaf's work has fallen under the categories of wearable sound art, sculptural installation, digital photography, video, telepresence art, animation, performance, and robotics. However, none of these labels are adequate in categorizing her body of work. This seems to be a common phenomenon for those practicing amongst and between disciplines. Having the freedom to be malleable in the choice of production methods and materials has always been of greater importance to Raaf then fitting a media sub-type. What drives her research and production is a fascination with designing sculptural systems that are fueled by real time data. Raaf is best known for making creative machines – machines that independently make art when cross-pollinated with the interaction of people around them. These artworks' behaviors are based in generative algorithms embedded within their circuitry. They rely on networks, reflexivity, and the interplay of randomness and pattern to initiate a genuine engagement with visitors. She views such innovations as tools for creating new experiential frameworks that question the very nature (or location) of authorship.

In 1999 Raaf began experimenting with transforming common elements of household and commercial building interiors into informative and metaphoric interfaces. Her first artwork along this line of inquiry was the Unstoppable Hum (1999). This was a large sculptural artwork that monitored various electro-mechanical activities in a building such as automatic doors, security, ventilation, computer and phone systems. It tracked their patterns of activity and then created musical compositions on the fly based on the complexity of activity in that space. Visitors were thereby informed about how often the structure around them was working towards maintaining the safety and comfort parameters of their habitat. In 2002 she created Dry Translator which included two custom designed audio vests and an interactive wall. When a gallery visitor touched the drywall of the gallery, they heard the sound of their touch not locally where their fingers hit the wall, but actually on their own torsos as the sound was amplified and transmitted wirelessly to the audio vest they were wearing. The walls thereby became skin-like extensions of the participant's own body. Participants were also able to record a series of touches or gestures on the drywall via an interactive consol and, in doing so, leave a "touch message" for the next participant to play back on the vest.

Her most recent research continues to focus on architectural interfaces but now also on telepresence and weightlessness. She produced a new series of video-enabled rovers (robotic vehicles) which participants may use to roam through accompanying sculptural superstructures. This work was inspired in part by the exploratory rovers sent to Mars in recent years as well as the concurrent proliferation of webcam feeds on the Internet. She is also currently focused on responsive environment design. This is a field of practice that combines smart architecture and infosthetics (real-time information visualization). Her area of interest within this field is combining interactive systems with experimental architectural forms. These methods allow her to create ambient social infrastructures as well as to generate emergent datascapes. In creating works like these, she hopes to add a future where technological innovation points further towards giving each person access to a deeper understanding of, and enhanced connectivity with, the world around them.

The Test People series of photographs depict a future time where a capacity for flight (or controlled antigravity) has been developed in humans. Its boundaries are being studied and tested in a semi-scientific manner. This documentation makes evident the awkward – although sometimes euphoric – struggle for the test subjects to integrate these new possibilities for movement into the strictly gravity-based architecture of their domestic environments. Anxiety and tensions develop during the test period. Aspects of real war and gaming creep in. The "home" spaces are revealed to not be real homes but decaying 20th century architecture left in a state of vacancy. These are some of the last tests to be recorded photographically.

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i Bad Camouflage, 2004, Archival Digital Print, 86"h × 30"w
ii Who Knew?, 2004, Archival Digital Print, 86"h × 26"w

Sabrina Raaf is a Chicago-based artist working in experimental sculptural media and photography. Her work has been presented in solo and group exhibitions at TEKS (Trondheim, Norway), Mejan Labs (Stockholm), Stefan Stux Gallery (NYC), Ars Electronica (Linz), Opel Villas Foundation Art Center (Rüsselsheim), Museum Tinguely (Basel), Espace Landowski (Paris), San Jose Museum of Art, Kunsthaus Graz (Austria), ISEA (Helsinki), Klein Art Works (Chicago), The Lab (San Francisco) and Painted Bride Center (Philadelphia). She is the recipient of a Creative Capital Grant in Emerging Fields (2002) and an Illinois Arts Council Fellowship (2005 & 2001). Reviews of her work have appeared in WIRED magazine, Make Magazine, Art in America, Contemporary, Modern Painter, Chicago Tribune Sunday Magazine, Gizmodo, Leonardo, www.lab71.org, The Washington Post, and New Art Examiner. She received an MFA in Art and Technology from the School of the Art Institute of Chicago (1999) and is currently Assistant Professor in Electronic Visualization in the School of Art and Design at the University of Illinois at Chicago.

Thecla Schiphorst

exhale: breath between bodies

"Thecla Schiphorst's artistic inquiry is founded on interests in embodiment and performativity, and in the sensual and poetic forms which cultivate human experience in relationship to perception, affect and the 'palpability' of the invisible, our own experience of ourselves through the very visceral nature of our bodies."

exhale is a whisper[s] research group project based on designing and fabricating "a-wearable" body networks for public spaces. The rhythm of networked group breath is used as an interface for interaction, and a mechanism for sharing our bodies' affective non-verbal data. We use the networked breath of the participants within the system to actuate the responses of small fans, vibrators and speakers that are embedded in the lining of sensually evocative skirts worn close to the body.The research integrates gestural interaction with fashion, developing new communication metaphors for wearable technologies network design.

Art and Science

This work embodies the confluence of artistic design and expression with software and hardware technology. The whisper[s] research group has collective backgrounds in fabric and garment design, choreography, and complex software systems, including both hardware and software architectures. The resulting work was influenced by their practices with modeling experience studies, networked micro-controllers, and real-time systems. It applies tools from choreography, such as Laban Effort/Shape Analysis along with linguistic and statistical analysis, to investigate the physiological data that the work utilizes. The garments employ conductive fabric, shaped equally by the needs of the electronic elements and the design aesthetics. Placement and organization of the sensors and transducers is guided by body ergonomics, bio-energy systems and interface design. Movement analysis is used to frame gestural interaction creating playful, intimate connections between participants.

Vision

In this work, garments are a step in a progression to systems that transparently exchange and express internal body state and intention via participant-mediated communication, mixing physiology-derived information with gestures and other nonverbal mechanisms. Concepts of device 'listening' and biofeedback enable what we term subtle machine learning. The garments provide an environment in which we can augment verbal and visual modes of communication, where the quality of a gesture can replace many words, and can be exchanged with their affects as well as their effects through out-of-band pathways.

Experience

The garments that are exhibited in Speculative Data and the Creative Imaginary are the networked artifacts that are 'brought into play' in the interactive installation called exhale: breath between bodies. Participants walk towards the darkened space, becoming aware of eight textured and sensual garments: skirts made of silks, and organza, natural fibers in earthy and vibrant tones, hanging from cables stretched from ceiling to floor. The visual image is a small forest of "skirt trees": skirts suspended at various heights in space, connected to vertical cables dropping in plumb lines to the earth. A light positioned at the base of each skirt illuminates it upward from below, highlighting and bringing light to its materiality. Guides assist the participant in putting on the skirt and wrapping the breath sensor around the rib cage. As a participant moves through the space, consciously shifting their own breathing cycle, they create the interactions of self to self, self to other, and self to group: wirelessly communicating and creating a shared breath state. And as the lining of each skirt 'breathes' with the participants, the small fans and vibrators respond to the breath beneath the lining unseen to others; the small speaker within the skirt marks the sounds of the breath data creating a body network that tickles and caresses and whispers from within.

Innovation

The core technical innovation of exhale: (breath between bodies) is integration of non-verbal models of network communication in a playful multi-modal environment, using layers of directionally conductive fabric to provide both electronic pathways within the garment systems and a sensual tactile experience for participants.

Connections between participants are realized through specialized electronics and embodied through acts of physical contact, designed using gestural models for interaction. The fabric that forms the conductive layers within the garment has electrical behavior due to its construction as a combination of very fine silver or gold wire with traditional materials such as silk. This conductive fabric is used as a replacement for conventional wiring, which is much heavier and less flexible. It is also used to form simple touch or pressure sensors, via contact between layers, and identification patches, using isolated fabric regions that include devices that have unique electronic signatures. Touch zones on the garment (or another garment) can make contact with these isolated regions, and the signature can be "read" to establish self-to-self, self-to-other, and self-to-group connections.

Acknowledgements

The whisper[s] research group includes Susan Kozel, Sang Mah, Gretchen Elsner, Robb Lovell, Diana Burgoyne, Norm Jaffe, Jan Erkku, Calvin Chow, Camille Baker, Lars Wilke and Adam Marston. Industry Contributors are Thought Technology, Tactex Inc and Credo- Interactive. Sponsors for the project include Heritage Canada, Canada Council for the Arts, B.C. Arts Council, Savage Media, CFI and I-Lab at Simon Fraser University.

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i – iv Garments designed for exhale: breath between bodies wearable technology project

Thecla Schiphorst is a Media Artist/Designer, and an Associate Professor in the School of Interactive Arts and Technology at Simon Fraser University in Vancouver, Canada. Her formal education and training in computing and dance form the interdisciplinary basis of her research, which integrates the design of human experience and movement with computational models of representation. She is the Director of the whisper[s] (wearable, handheld, intimate, sensory, personal, expectant, responsive systems) research group, which focuses on design for wearable or 'holdable' technologies. Schiphorst is a member of the original design team that developed the Life Forms software, a computer application for choreography notation and composition. Merce Cunningham has been an avid user of the Life Forms tool in support of his choreography and computer mediated stage performances since 1990. Schiphorst is the recipient of the 1998 PetroCanada award in New Media from the Canada Council for the Arts. Her media art and design installations have been exhibited internationally in Europe, Canada, the United States and Asia in venues such as Ars Electronica, DEAF (the Dutch Electronic Arts Festival) Future Physical, SIGGRAPH, Interaction '97 in GIFU, Japan, the Wexner Centre for the Arts, the Montreal NewMedia Festival, ISEA, SVA in New York, the Canadian Cultural Centre in Paris, and Dance Umbrella at the London ICA. Her graduate work includes an interdisciplinary Masters of Art in computer compositional systems for dance and computer graphics from Simon Fraser University in Canada, and work toward the completion of her Ph.D. in the Center for Advanced Inquiry in Integrative Arts in the School of Computing, University of Plymouth, United Kingdom.

Bill Seaman

The Hybrid Invention Generator (2002)

"The Hybrid Invention Generator provides an environment for rich associative and contemplative activity surrounding the notion of invention....It is through the combination and recombination of evocative digital fields of meaning, as experienced by an engaged participant, that a new form of poetics called Recombinant Poetics can be explored."

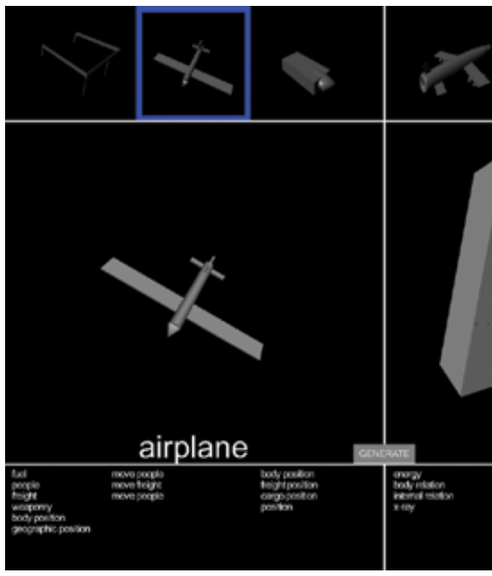
The Hybrid Invention Generator plays with process of re-contextualization. It serves as a brainstorming tool to explore seemingly illogical combinations of objects that have the possibility of generating ideas for new inventions. It is the computer-based dream-like nature of the productions of the Hybrid Invention Generator that spark the imagination. The generator enables effortless substitution of media elements to produce combinations or media-configurations of image, sound and text. This work is part of Seaman's research and creative practices exploring the design and implications of recombinant poetics – an expanded media-language that includes the juxtaposition of text, images, objects and code. Seaman examines through technological means the peripheries of meaning and the complexities of the production of meaning by the active participant. It is this playful, poignant, intentional exploration of "reframing" that Seaman's recombinant poetic works seek to point at through interactive engagement. He utilizes displacement and re-framing as specific aesthetic strategies.

Two scrolling sets of inventions are presented as three-dimensional objects. Participants can move this "train" or "conveyor belt" of inventions and observe differing devices. Each invention has a specific authored database, providing additional information related to a set of potential ways of understanding these devices in terms of "Input", "Functionality" and "Output". The user of the system can select a particular "invention" by touching the screen. A single invention is then presented on half of the screen, under the selection "train". This invention appears as a three-dimensional model that can be oriented in space by the participant. The user now selects a second invention/object from the alternate menu. Once the second invention is chosen, a juxtaposition of the two inventions is presented – one on the left side of the viewing screen, a second on the right side. A repetitive audio track accompanies each invention and changes as each different invention is viewed.

An elaborate set of "Conjunction Codes" have been developed that suggest differing ways of bridging the output of one invention with the input of the other device by suggesting different ways that the output from one device could be translated into a form that could functionally become the input of the second device. Sometimes highly suggestive of a workable device, while other times more humorous or contemplative in nature, the "conjunction codes" provide an interesting field of association for the participant. They are presented at the bottom of the screen after the participant selects the "generate" button. These lines of text are run together, and in a literal/poetic manner reflect the merging of the two chosen devices.

Inspiration for this project comes in part from the fact that the historical process of invention has been preceded by kluging together seemingly disparate ideas, objects, and prior inventions. The history of the design of the computer provides a prime example of how seemingly illogical mechanisms were brought together to make a radical jump in terms of functionality from the power loom, to the typewriter and graphic display mechanisms.

The Hybrid Invention Generator thus becomes a brainstorming tool for such illogical combinations for inventing the future. The Hybrid Invention Generator is an instrument for meta-invention that bridges artistic, philosophical and literary methods of creative invention with the generation of conceptual machines. It is a playful and sometimes illogical exploration of logic provided by use of the Hybrid Invention Generator, enables one to interactively explore the borders of logic. One notes that there is a place for experimentation and a place for absolute clear-headed functionality. Yet, the logical/poetic realm supported in the Hybrid Invention Generator teeters on a line that embraces both a very large logical complex system, as well as the absurdities that arise through exploration of that system. This can be said is also central to the intuitions surrounding the development of new inventions – an attitude of openness about creative solutions. In this case the conceptual history of each device, reframes the other – sometimes humorously, sometimes expressively. The hybrid mechanisms that the computer can engender are associative and contemplative in nature. Defining the edge of logic is an interesting undertaking.



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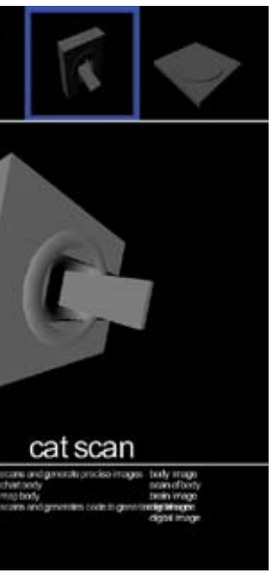
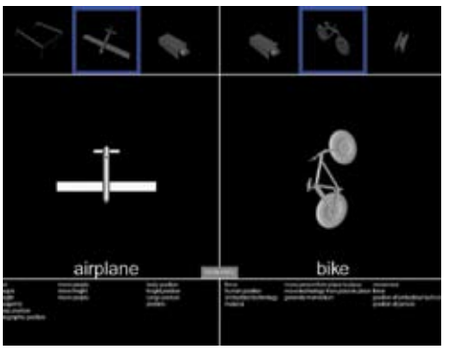
This is not to say that such potentials do not have their dangers. Thus the mechanism also generates the visualizations of "monsters" and humorous devices that suggestively auto-critique this emergent process.

The Hybrid Invention Generator was developed in collaboration with Gideon May and funded by Intel.





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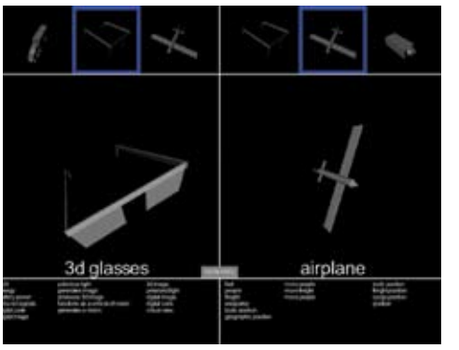

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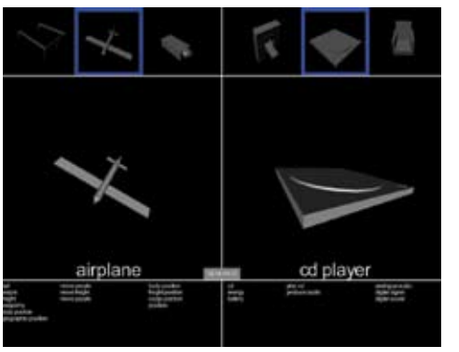

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i – vi Screen images from the Hybrid Generator project.

Bill Seaman Ph.D. is Chair of the Graduate Digital+ Media Department at Rhode Island School of Design where he is exploring issues related to the continuum between physical and virtual/media space and expanded media-oriented poetics he calls Recombinant Poetics. Seaman has been awarded prizes from Ars Electronica in Interactive Art (1992 &1995, Linz, Austria); International Video Art Prize, ZKM, Karlsruhe, Germany; Bonn Videonale prize; First Prize, Berlin Film / Video Festival, for Multimedia in 1995; and the Awards in the Visual Arts Prize. Seaman was given the Leonardo Award for Excellence in 2002 for his article – OULIPO | vs | Recombinant Poetics. He has been very active as a writer/media theorist since 1999. Selected exhibitions include 1996, Mediascape Guggenheim, New York; the premiere exhibition in 1997 of the ZKM in Karlsruhe, Germany; 1997, Barbican Centre (London); 1997, C3 – Center for Culture & Communication, Budapest, Hungary ; in 1998, Portable Sacred Grounds, NTT-ICC Tokyo; Body Mechanique, The Wexner Center, Columbus, Ohio, 1999. He presented a major solo show Exchange Fields at the David Winton Bell Galleryat Brown University with collaborative work with dancer/choreographer Regina Van Berkel, commissioned by Vision Ruhr exhibition, Dortmund, Germany. Seaman contributed a video set for the production of SLEEPERS GUTS by William Forsythe and Ballet Frankfurt. He was also commissioned by the National Gallery of Canada for the interactive work Red Dice / Dés Chiffrés that toured at the Holland Dance Festival, the Steps Festival in Lausanne Switzerland, and Cologne, Germany. He is currently working on a series of installations in conversation with the Scientist Otto Rössler – The Thought-body Environment. They are articulating a model for a neo-sentient situated robotic system and models for an advanced electrochemical computing paradigm, Seaman received a Ph.D. from the Centre for Advanced Inquiry In Integrative Arts (CAiiA), University of Wales, Newport, 1999. He holds a Master of Science in Visual Studies degree from the Massachusetts Institute of Technology, 1985.

Gideon May was born in the Netherlands in 1964. Following a career in various capacities in media production from special effects to still photography, he began working as a freelance programmer for artists and commercial companies in 1987. From 1990 to 1993 he was head of software development, Institute for Image Media, Centre for Art and Media Technology, Karlsruhe (ZKM). In addition to his own work as an artist, which has been exhibited widely throughout Europe, he has programmed many significant art projects for a diverse range of practitioners including Jeffrey Shaw, Michael and Anna Saup, and Bill Seaman.

Christa Sommerer & Laurent Mignonneau

Life Spacies II (1999)

"Based upon the insight that interaction per se and the interrelation between entities are the driving forces for the structures of life, Sommerer and Mignonneau are investigating the interaction and creative process as such. Creation is not any more understood as expression of the artists' inner creativity or ingenuity but instead becomes itself an intrinsically dynamic process that is based upon the interaction parameters and the evolutionary image processes of the work."

Complex Science Systems

Creating virtual life on computers ultimately brings up the question of how life has emerged on earth and how it could have developed from simpler units or particles into increasingly complex structures or whole systems of structures that seem to follow a certain inner rule of organization. This is also the central question in the new Complex System Sciences. Complex System Sciences, as a field of research, has emerged in the past decade. It studies how parts of a system give rise to the collective behaviors of the system and how the system interacts with its environment. Social systems formed (in part) out of people, the brain formed out of neurons, molecules formed out of atoms, the weather formed out of air currents are all examples of complex systems. The field of complex systems cuts across all traditional disciplines of science as well as engineering, management, and medicine. It focuses on certain questions about parts, wholes and relationships. Although there is no exact definition of what a Complex System is, there is now an understanding that, when a set of evolving autonomous particles or agents interact, the resulting global system displays emergent collective properties, evolution and critical behavior that have universal characteristics. These agents or particles may be complex molecules, cells, living organisms, animal groups, human societies, industrial firms, competing technologies, etc. All of them are aggregates of matter, energy, and information that display the following characteristics. They couple to each other, learn, adapt and organize, mutate and evolve, expand their diversity, react to their neighbors and to external control, explore their options, replicate, organize a hierarchy of higher-order structures.

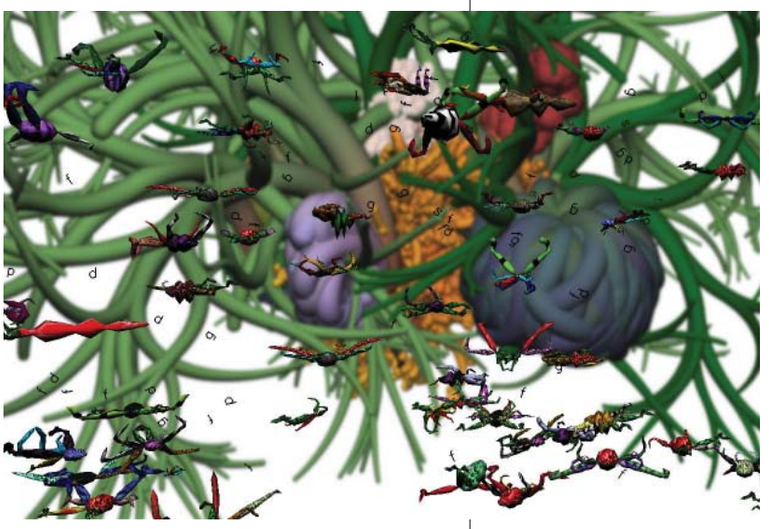
Life Spacies II – Modeling Complexity for Interactive Art

Based on the objective to create an interactive artwork, that should display some of the features of complex systems, Sommerer and Mignonneau created a system called Life Spacies II. Life Spacies II is an interactive artificial life environment that enables users to create artificial creatures that form an emerging evolutionary system. This is accomplished by typing text messages that are transformed into artificial life creatures. "Life Spacies II" consists of a graphical user interface (GUI) that allows users to type text messages into the Internet web page text editor. Written text is used as genetic code to create three-dimensional forms. In addition to creating creatures, user can feed their creatures by releasing text characters on the GUI. Food particles are in fact text characters, and the user can decide how much text, which type of text, and where to place the text by typing specific text characters within the GUI of the web page. Instantaneously, the text (food) is shown and picked up by the creatures on the large projection screen. The "text-to-form editor" takes written text as genetic code and translates it into visual forms. In a way similar to the genetic code in nature, letters, syntax and sequencing of the text is used to code certain parameters in the creature's design functions. The text parameters and their combinations influence form, shape, color, texture and the number of bodies and limbs. As there is a great variation in the texts sent by different people, the creatures themselves also vary greatly in their appearance. The default form of a creature is a body composed of a sphere consisting of 100 vertices, that is, 10 rings with 10 vertices each. All vertices can be modified in x, y and z axes to stretch the sphere and create new body forms. Several bodies can be attached to each other or a pair of limbs can be created. According to the sequencing of the characters within the text, the parameters of x, y and z for each of the 100 vertices can be stretched and scaled, the colour values and texture values for each body and limb can be modified, the number of bodies and limbs can be changed, and new locations for attachment points of bodies and limbs can be created. Since each of the vertex parameters is changeable and all of the bodies and limbs can be changed as well, about 50 different design functions for the creature's design parameters are available. As there is great variation in the texts sent by different people, the creatures themselves also vary greatly.

Behavior of the Creatures

As the users interact with these systems, the systems themselves become increasingly complex, displaying some of the features of complex systems such as variety and dependency, irreducibility, symmetry breaking, adaptation and organization, mutation and evolution, expansion of diversity, reaction to neighbors and to external control, exploration of their options, and replication.

A creature's behavior is basically dependent on two parameters: a) its Energy level (E) and b) its Speed (S) or ability to move. While the Energy level (E) is a value that constantly changes as the creature moves in its environment and decreases by increased movement, the Speed (S) value is designed by the creature's body physics. A creature with a large body and small limbs will typically move more slowly than a creature with a small body and long limbs. Additionally, the shape of the creature's body and limbs has an influence on its ability to move. On the other hand, the Speed(S) value is set at creation through the arrangement of text characters in the creature's genetic code, which is interpreted and translated by a design function table. The creature's interaction with other creatures is based on how much Energy (E) it has at a given moment and the Speed (S) with which it can move in the environment. A creature whose Energy level has risen to E < 1 becomes virtually hungry and desires to eat text characters provided by the user through the text input editor. The kind of text characters released depends solely on the user's decision and the place where the food is released can be directed by the user as well. Creatures also have preferences for certain types of food and only eat text characters contained in their genetic message. For example, a creature whose genetic code is 'John' will only eat 'J', 'o', 'h', and 'n' characters. By eating text characters, the creature will manage to accumulate a certain amount of energy, and eventually its Energy level can again rise to E > 1. Given that a creature succeeds in adding energy to the level of E > 1, it becomes a potential mating partner. It will now look for a suitable mate, whose energy level is also above 1. The two potential parent creatures will now move toward each other and try to collide. If successful, the two parents exchange their genetic code through a cross-over operation and, as a result, a child creature is born. This offspring creature carries the genetic code of its parents with some mutations. A creature's lifetime is not pre-determined but influenced by how much it eats. Through eating the creature increases its body size until reaching a maximum size of about four times the original body size. On the other hand, a creature will starve when it does not eat enough text characters and ultimately die and sink to the ground.



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This work was commissioned by the ICC-NTT InterCommunication Museum in Tokyo. The first version Life Spacies was shown in spring 1997. The artificial life and genetic programming techniques used for Life Spacies II came from their previous interactive evolutionary systems. Sommerer and Mignonneau collaborated with programmer Roberto Lopez-Gulliver at the ATR Media Integration and Communications Research Lab, Kyoto Japan on this project.

Text excerpts from: Modeling Complex Systems for Interactive Art, C. Sommerer 1, and L. Mignonneau 2. Published in: Applied Complexity – From Neural Nets to Managed Landscapes, edited by S. Halloy and T. Williams (Institute for Crop & Food Research, Christchurch, New Zealand, 2000), pp.25-38.

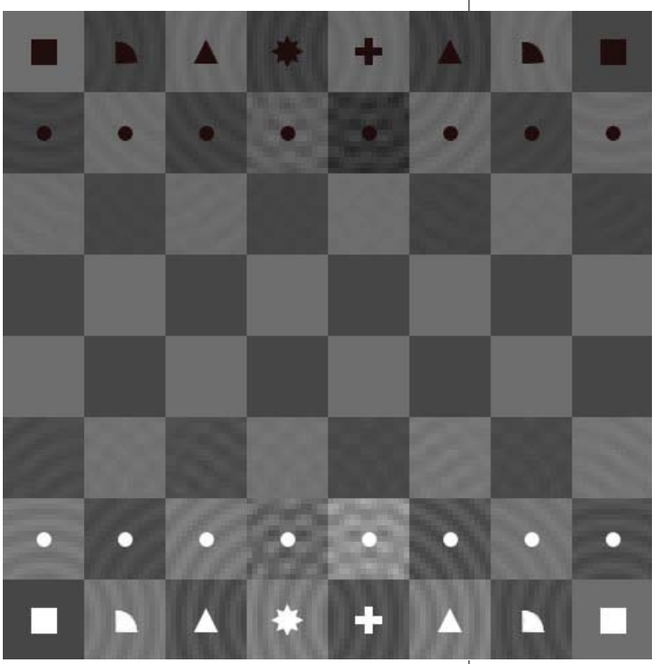
i Screen image from Life Spacies II artificial life interactive ecology.

Christa Sommerer Ph.D. and Laurent Mignonneau Ph.D. are internationally renowned media artists working in the field of interactive computer installation. They are Professors at the University of Art and Design in Linz Austria where they head the Department for Interface Culture at the Institute for Media. Sommerer and Mignonneau previously held positions as Professors at the IAMAS International Academy of Media Arts and Sciences in Gifu, Japan and as Researchers and Artistic Directors at the ATR Media Integration and Communications Research Lab in Kyoto Japan. They also were Visiting Researchers at the MIT CAVS in Cambridge US, the Beckmann Institute in Champaign Urbana, IL, USA and the NTT-InterCommunication Center in Tokyo. Sommerer originally studied biology (botany) at the University of Vienna and modern sculpture and art education at the Academy of Fine Arts in Vienna (masters degree). Mignonneau studied modern Art and Video Art at the "Ecole des Beaux Arts" in Angouleme, France where he received his masters degree. Sommerer and Mignonneau completed their PhD degrees from CAiiA-STAR, University of Wales College of Art, Newport, UK and the University of Kobe Japan, respectively. In 1992 Sommerer and Mignonneau met at the Institute for New Media at the Staedelschule in Frankfurt where they teamed up and started their collaboration in the area of interactive computer installations. Mignonneau and Sommerer's artworks have been called "epoch making" (Toshiharu Itoh, NTT-ICC museum) for developing natural and intuitive interfaces and for often applying scientific principles such as artificial life, complexity and generative systems to their innovative interface designs. Mignonneau and Sommerer created pioneering interactive computer installations since 1993 that are well documented on their web site, http://www.interface.ufg.ac.at/christa-laurent/. Their works have been shown in nearly 150 exhibitions world-wide and are permanently installed in media museums and media collections around the world, including the Media Museum of the ZKM in Karlsruhe, Germany, the NTT-ICC InterCommunication Center in Tokyo, the Cartier Foundation in Paris, the Millennium Dome in London, the Tokyo Metropolitan Museum of Photography in Japan, the AEC Ars Electronica Center in Linz, Austria, the NTT Plan-Net in Nagoya, Japan, Shiroishi Multimedia Art Center in Shiroishi, Japan and the HOUSE-OF-SHISEIDO in Tokyo. Sommerer and Mignonneau have won mayor international media awards, for example the "Golden Nica" Ars Electronica Award for Interactive Art 1994 (Linz, Austria), the "Ovation Award" of the Interactive Media Festival 1995 (Los Angeles, USA), the "Multi Media Award '95" of the Multimedia Association Japan and the" World Technology Award" in London (2001). Sommerer and Mignonneau have published numerous research papers on Artificial Life, interactivity and interface design and they lectured extensively at universities, international conferences, and symposia. Sommerer is an International Co-editor for the LEONARDO Journal, MIT Press and in 1998, together with Laurent Mignonneau; she edited a book on the collaboration of art and science called "Art@Science," published by Springer Verlag.

Thinking Machine 4 (2003 – 2004)

"An exploration of behavior as a constantly changing series of choices. Play chess against a transparent intelligence and watch its evolving thought process on the board before you."

Thinking Machine 4 is an artificial intelligence program – ready, willing and able to play chess with the viewer. If the viewer confronts the program, the computer's thought process is sketched on screen as it plays. A map is created from the traces of literally thousands of possible futures as the program tries to decide its best move. Those traces become a key to the invisible lines of force in the game as well as a window into the spirit of a thinking machine. The pace of interaction is deliberative, unlike the rushed tempo of popular video games. Indeed the true subject of the piece is not games or chess, but contemplation and introspection. Thinking Machine 4 was designed in collaboration with Marek Walczak.



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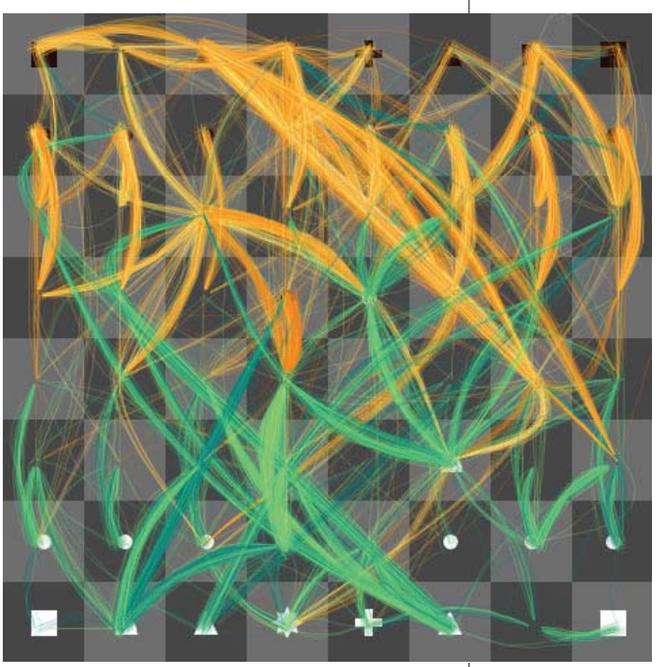

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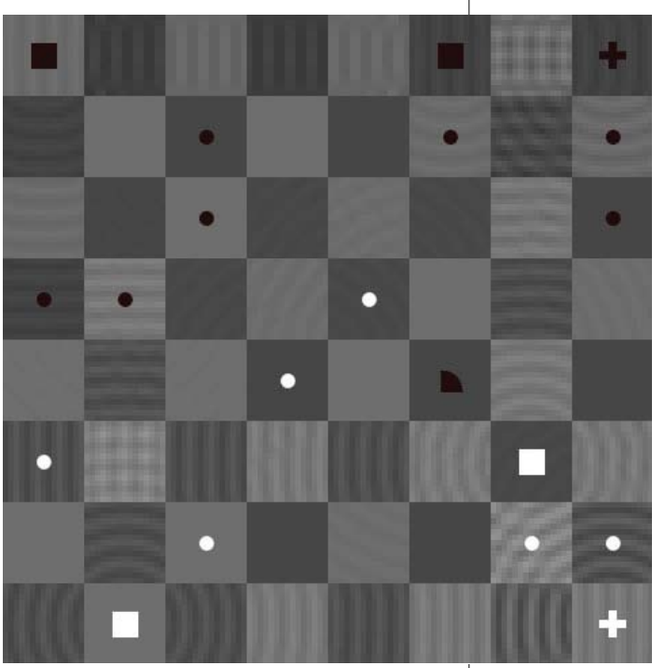

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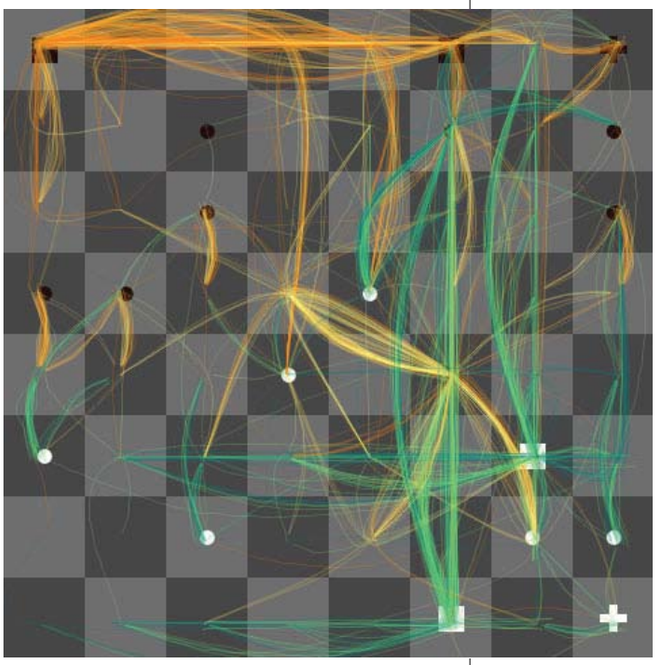

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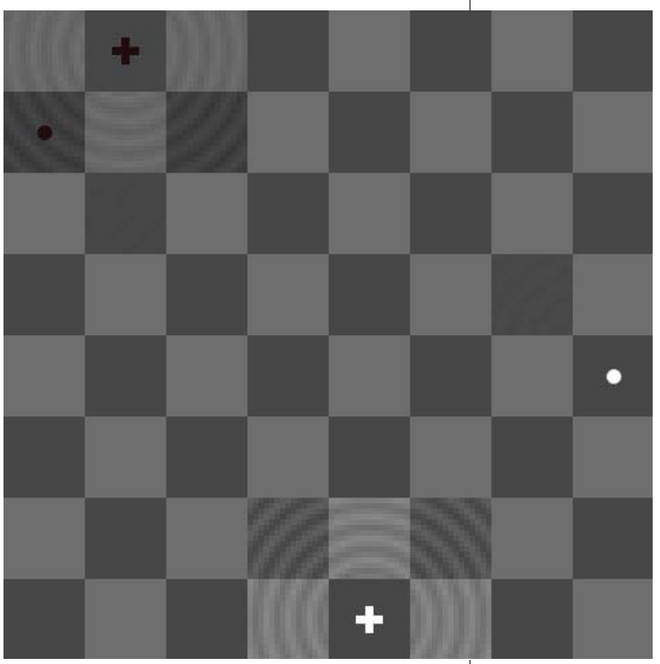

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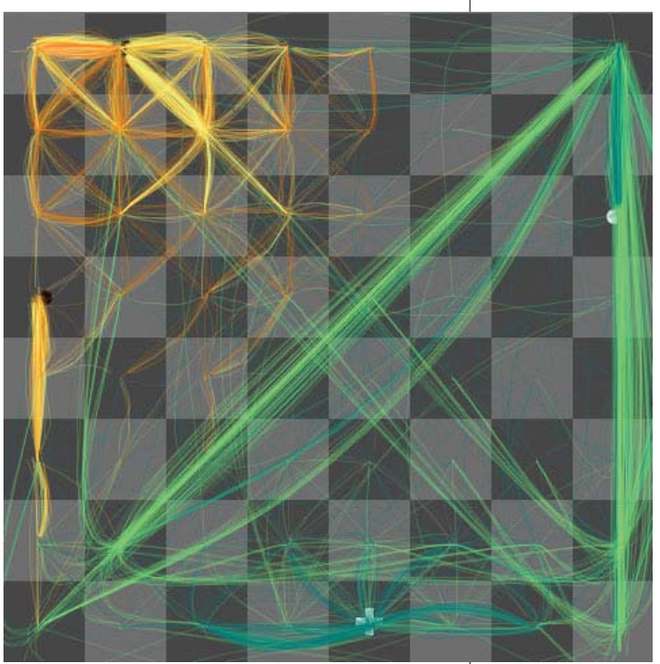

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i Waves of influence, opening. The player sees the initial position, with waves of force radiating out from the pieces.
ii The machine's thoughts, opening. The machine has many choices future lines of play cover the board
iii Waves of influence, mid-game. The middle game, as the player thinks.
iv The machine's thoughts, mid-game. The lines of play become more focused.
v Waves of influence, endgame. The board is deceptively simple as the player thinks.
vi The machine's thoughts, endgame. The machine foresees that white's pawn will become a queen, and dominate the board as the black king flees.

Martin Wattenberg Ph.D. is a researcher at IBM whose work focuses on visual explorations of culturally significant data. His algorithmic approach is informed by his background in mathematics. Wattenberg is equally known for his scientific and applied work in the field of information visualization, and for his information-based digital artwork. In his work, the mathematical underpinnings of a computer program are not simply tools used to create art; they are the core of the artworks themselves. Technology Review recently named him "one of the world's 100 top young innovators." Wattenberg's artwork has been exhibited at The London Institute of Contemporary Art, The Whitney Museum of American Art, Ars Electronica, The New Museum, and at galleries and festivals internationally. Commissions include The Whitney Museum of American Art, The Smithsonian National Museum of American History, The NASA Art Program, Ars Electronica, New Radio and Performing Arts, and The Walker Art Center. His projects have been honored by the Columbia Journalism School Online Journalism Award and the National Magazine Award (with SmartMoney.com), the ID Magazine Interactive Media Design Review, the IDSA Industrial Design Excellence Award, and the Graz Biennale of Media and Architecture with Marek Walczak with whom he frequently collaborate since 1997 under the name MW2MW. Wattenberg received his Ph.D. in mathematics from U.C. Berkeley, M.S. from Stanford University, and A.B. from Brown University.

Exhibition Sponsors

Office of Exhibitions and Cultural Programs of the National Academy of Sciences presenting a program of exhibitions that explore relationships among the arts and sciences, engineering and medicine.

http://www7.nationalacademies.org/arts/

The 2007 Association for Computing Machinery Creativity and Cognition Conference held in Washington D.C. June 13th – 15th, 2007, exploring the theme of cultivating and sustaining creativity: understanding how to design and evaluate computational support tools, digital media, and socio-technical environments that not only empower our creative processes and abilities, but that also encourage and nurture creative mindsets and lifestyles.

http://www.cs.umd.edu/hcil/CC2007/

National Science Foundation Computer, Information Science and Engineering (CISE) Creative IT Program, exploring the synergies between creativity and information technology, science, engineering, and design research.

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This catalog is dedicated to the loving memory of Julia M. Jennings (1935 - 2007)

Credits

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All texts were written by the exhibition participants.

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