Visual Proceedings

COMPUTER GRAPHICS Annual Conference Series / 1996
A Publication of ACM SIGGRAPH

The Art and Interdisciplinary Programs of SIGGRAPH 96

Visual Proceedings

COMPUTER GRAPHICS Annual Conference Series / 1996
A Publication of ACM SIGGRAPH

The Art and Interdisciplinary Programs of SIGGRAPH 96

SIGGRAPH 96

NEW ORLEANS

Edited by

BRIAN BLAU & CLARK DODSWORTH • *Digital Bayou Co-Chairs*

LINDA BRANAGAN • *Computer Animation Festival Chair*

JEAN IPPOLITO • *The Bridge Chair*

KEN MUSGRAVE • *Sketches Chair*

WARREN WAGGENSPACK • *Applications Chair*

VISUAL PROCEEDINGS
The Art and Intersisciplinary Programs
of SIGGRAPH 96

COMPUTER GRAPHICS
Annual Conference Series, 1996

The Association for Computing Machinery, Inc.
1515 Broadway
New York, New York 10036 USA

ISBN 0-89791-784-7
ISSN 1069-5419
ACM Order No. 428961

Additional copies may be ordered pre-paid from:
ACM Order Department
P.O. Box 12114
Church Street Station
New York, New York 10257 USA

Or, for information on accepted European
currencies and exchange rates, contact:
ACM European Service Center
108 Cowley Road
Oxford OX4 1JF
United Kingdom
+44.1.865.382338
+44.1.865.381338 fax
acm_europe@acm.org

Credit card orders from the U.S. and Canada:
800.342.6626

Credit card orders from the New York
Metropolitan area and outside the U.S.:
+1.212.626.0500

Single copy orders placed by fax:
+1.212.944.1318

Credit card orders may also be placed by mail.

Electronic mail inquires may be directed to :
orders@acm.org

Please include your ACM member number and the
ACM order number with your order.

Contents

The Bridge

The Bridge

Welcome to The Bridge

We're here.
We've reached The Bridge.
Now let's cross.

A bridge is a construction spanning a gap between two points. It is usually built high enough above the ground to allow unobstructed passage beneath. There are various kinds of bridges: girder, arch, suspension, and cantilever bridges to name a few. There are movable bridges: the drawbridge, the swing bridge, and the bascule bridge. Bridge is also the name of a card game played by two sets of partners. To burn one's bridges means to end any possible means of retreat. *Die Brücke*, the German equivalent of The Bridge, refers to a group of German expressionist painters of the early 20th century. There are dental bridges, the bridge of the nose, and bridge passages in literature. There are also literal, social, and, of course, metaphorical bridges. Some fear crossing bridges, others find it exhilarating.

Bridges have come to serve as metaphors for meeting challenges, moving forward, overcoming obstacles, or adjusting to change. Each person approaches a bridge with a different mindset. Some are indifferent, some approach with hesitation and fear of the unknown, others are attracted to the mystery and meet the challenge head on. Still others prefer not to think about the how or why until the time comes when they must: "We'll cross that bridge when we come to it." So the saying goes.

The Bridge is here, now, at SIGGRAPH 96. We have constructed a bridge between the Contemporary Arts Center and the Ernest N. Morial Convention Center in New Orleans. A T3 line spans the gap of five city blocks between the two sites, allowing free access via the Internet to either side. The T3-line bridge connects one site of the show to its mirror site; it also connects the contributing artists to each other, the Internet, the World Wide Web, and the show's visitors.

The Bridge, however, is not just electronic. It is also a metaphorical bridge that connects current issues, bringing together art and technology, bridging gaps between international and regional audiences, spanning issues of gender, race, religion, culture, high art, and the general public.

There is no longer a question about the validity of art made with computer technology. We have crossed that bridge. The purpose of this bridge is to raise awareness and to facilitate an understanding of current issues through the use of art and technology. The show may raise more questions than it answers, but it is designed to draw in a wide range of audiences and to initiate discussion. We hope you find it enticing, provocative, and intellectually stimulating.

Go ahead, do it…
steady now, go forward…
cross…
The Bridge.

JEAN IPPOLITO
The Bridge Chair

A Note from the Special Projects Coordinator

When I first climbed on board The Bridge as the Special Projects Coordinator, I was both intrigued and mystified at the challenges that lay ahead. Having viewed several SIGGRAPH Art Shows in the past, as only a spectator, I was unaware of the time and preparation involved in putting together an exhibition of this caliber. Now, after hundreds of telephone calls, email communications with artists, 12-hour work days, bitten fingernails, countless tears, and gut-wrenching laughter, I have a tremendous amount of respect for the chair, committee members, artists, and others who contribute to SIGGRAPH Art Shows. Working with The Bridge has "spanned a gap" from my role as idle spectator to my new experience as one as energetic participant. I am grateful to the committee for facilitating my journey across The Bridge.

LORI CRAWFORD

The Bridge: SIGGRAPH 96 Art Show Committee

Chair
JEAN M. IPPOLITO
Savannah College of Art and Design

The Bridge Curatorial Committee

CAROL GIGLIOTTI
The Ohio State University

THOMAS WHITWORTH
University of New Orleans

SERGIO LAUREANO
Fould and Associates

LUCY PETROVICH
Savannah College of Art and Design

The Bridge Curatorial Advisors

BARBARA LONDON
Museum of Modern Art

TED POTTER
Contemporary Arts Center

The Bridge Space Designer

NATHANIEL QUINCY BELCHER
Tulane University

The Bridge Special Projects Coordinator

LORI CRAWFORD
Savannah College of Art and Design

The Bridge Editors

JEAN IPPOLITO AND LUKE WANDER
(artists essays)

CAROL GIGLIOTTI
(critical essays)

The Bridge Research Assistants

FRED CLARK
CHRIS FORD
DANE SHEARS
LORI CRAWFORD
TRACY INMAN
MITHEERA KALYANAMITRA
MICHELLE KAPA
JOHN KING
SILVANA VIVANCO
JENNIFER CHEN

In the dream, I am driving over the Charleston Bay Bridge in South Carolina. As I reach the crest of the bridge, my car veers, lifts, and suddenly, without the car, I am flying high over the bridge and the bay. It is snowing, and I am very cold, high in the dark blue night above an even darker blue sea. I realize I am numb. I am dead, I think. It is not an unhappy thought. Thinking I am dead brings a wonderfully exhilarating and freeing sensation. I am at peace.

An overwhelming feeling of panic washes over me, and I wake myself up with a jolt.

My relationship with bridges has never been quite the same since that dream in December of 1975. For many nights and mornings, as I drove myself back and forth to my waking, working life at the Charleston County Hospital, I wrestled with the meaning of the dream. I also struggled with a developing fear of crossing any bridge, a fear that is with me to this day. In the intervening years, I have had to cross no small amount of bridges, and so have come to understand in detail my fear and how to overcome it.

There are two crucial moments in crossing a bridge: the approach and just before the crest. Negotiating the approach relies heavily on rational forms of perception. Here I have found that a kind of mental, dispassionate argument works best. Before hitting the bridge itself, there are usually opportunities to pull off. One simply sits on the last bit of solid land and perceives arguments for crossing: a stream of cars *appears* to be crossing safely to the other shore; the bridge itself *appears* to be structurally sound. If these arguments fail, one has the option of turning the car around and heading off in search of another route, preferably one without a bridge, and failing that, a low, short one.

If the approach is conquered, however, one faces the site of the most severe panic, just before the downside of the span is visible. After all these years, I have come to realize that what I fear most about bridge crossing is not being able to see over the crest of the span. Before I can see over the crest, the vivid catastrophic images first sparked by the dream and then actively developed in my imagination cause my heart to pound, my hands and face to sweat, and my body to shake uncontrollably. Fear is spurred on by my imagination. At the same time, that same fear restrains me from imagining what else I can not see but need to imaginatively sense: the existence of what lies beyond the crest of the span. Though considered reason can get me on to the bridge, only a felt sense of the possibilities beyond the crest of the bridge will get me over it.

The goal of this short essay is two-fold: to advocate the fundamental necessity of collaborations between art and technology for social change, and to investigate, although briefly, obstacles to the powerful role imagination plays in the development of those collaborations. Overcoming a debilitating phobia, one whose demoralizing repercussions have, at times, threatened to limit many areas of my life, may not at first appear to be an appropriate example of the creative process. It has, however, highlighted for me, in extreme contrasting tones, the essential and extensive nature of imagination. Imagination need not be defined as a gift belonging to a special few, or a human propensity for fancy, but as an integral and guiding force in much of human activity and accomplishment.

This definition of imagination opens up previously obscured opportunities for those of us actively and consciously engaged in understanding and developing the values that exist in this culture's present and increasingly intense involvement with computer technology across numerous disciplines and areas of activity.

Imagination plays an enormous and pivotal role in these involvements. The historic reasons for the obfuscation of collaborative opportunities between art and technology despite constant philosophical, aesthetic, pedagogical, and scientific attempts to cross those boundaries since the early part of this century have been outlined in depth elsewhere[8]. My belief is that the kind of intense experiential understanding of imagination that I have described above must inform the two stated goals of this essay. Additionally, however, I would like to explore another individual's investigations of the significance of imagination. John Dewey's definition of imagination and the role it plays in bridging thought, action, and that area of human understanding so little mentioned, so often ignored in contemporary life, wisdom, is pertinent to the goals of this essay.

Situating this particular investigation in the SIGGRAPH 96 Visual Proceedings animates its theoretical form. A first time SIGGRAPH visitor might ask: "What is an art exhibit doing in a computer graphics conference?" The quick and dirty answer to that question lies within the history of SIGGRAPH. It is particularly telling that this essay appears in the *Visual Proceedings: The Art and Interdisciplinary Programs of SIGGRAPH 96*. Though a number of projects have managed to slip across the boundaries over the years, art, as a specific discipline, is still cordoned off from other areas of interdisciplinary activity, such as education, for example, or the building of social communities on the Internet, or health care, or film, or, for that matter, issues of computer interface design.

I quote John Dewey's ideas at length here for several reasons. The first is that much of contemporary American cultural criticism refers to themes first articulated, in the United States, at least, throughout Dewey's writings. Far from being simply a philosopher of the arts, Dewey is seen by contemporary philosophers, such as Cornell West, as "the towering force in American philosophy."[9] According to West, Dewey's contribution enables us

> to view clashing conceptions of philosophy as struggles over cultural ways of life, as attempts to define the role and function of intellectual authorities in culture and society.[9]

The second reason for a rereading of Dewey is that he is the earliest American proponent of a participatory aesthetic, as well as an advocate of the importance of understanding the participatory nature of scientific investigation. Berleant, in his seminal book on contemporary aesthetics, *Art as Engagement*, lists Dewey with Bergson[2] and Merleau-Ponty[7] as early proponents of an aesthetic stressing "the active nature of aesthetic experience and its essential participatory quality."[1] Though as Berleant points out, this aesthetic has its origins in subversive alternatives to any number of traditions from classical times through the Enlightenment to the present, the emergence of this aesthetic may be historically and politically located in the United States by Dewey's articulation of it in 1934, in *Art as Experience*.[3]

This brings me to my third and primary reason for singling out Dewey. Dewey's writings and career are instructive in their questions of value similar to those with which we continue to struggle. For Dewey, simultaneously understanding and reconstructing the methods of inquiry through which these questions are mediated, are instigated first and foremost by a desire to nurture and support a world in which human beings are able to create their own conditions and their own identities.

Obstacles to creating these individual and communal identities, needs, and desires, exist, though often surreptitiously, in the particular and expedient bargains made between knowledge, authority, and power. Art itself is not the answer to breaking down those barriers, for art exists within particular cultures and is just as vulnerable to the integration of those obstacles. Within the aesthetic experience, however, Dewey finds methodologies, if you will, of thought and feeling attuned most closely with his project of participatory and creative democracy. Watching him contend with his thoughts on the aesthetic experience compels an understanding of these ideas within the larger context of his work. His work concerns itself with the understanding of intellectual activity as it relates to the particulars of social, economic and political life. As West declares:

> John Dewey is the culmination of the tradition of American pragmatism. After him, to be a pragmatist is to be a social critic, literary critic, or a poet - in short, a participant in cultural criticism and cultural creation.[9]

Dewey, in describing imagination in artmaking, says: "Possibilities are embodied in works of art that are not elsewhere actualized; this embodiment is the best evidence that can be found of the true nature of imagination."[4] Dewey is careful to point out that his definition of art includes, "…philosophic, scientific, technological and esthetic"[5] involvements. For Dewey, these arts:

> all have finally the same material; that which is constituted by the interaction of the live creature with its surroundings. They differ in the media by which they convey and express this material, not in the material itself.[4]

He is careful to distinguish these possibilities from the fanciful or the imaginary, in which he finds that "mind and material do not squarely meet and interpenetrate."[5] For Dewey, products of the fanciful or imaginary lack a strong sense of material quality, emotion or meaning, and so, cannot truly be considered essential art.

He also disagrees with those who might describe imagination as "a special and self-contained faculty, differing from others in possession of mysterious potencies."[4] Instead, he sees it as a "quality that animates and pervades all processes of making and observation."[4] Imagination, rather than being seen as a quality set against reason, may be understood as that quality which encompasses reason. Crucial to his descriptions of what constitutes imagination is a generosity of interests and a blending of internal and external experience.

In describing these embodied possibilities as "the means of keeping alive the sense of purposes that outrun evidence and of meanings that transcend indurated habit,"[6] Dewey is attempting to articulate the way in which the aesthetic experience provides an understanding of the world that goes beyond the particular necessities of cultural, political, and economic situatedness. At the same time, same experience acknowledges those necessities and the choices we must constantly make to meet their demands as essential to affording that experience. Agreeing with Shelley, he says:

> Imagination is the chief instrument of the good. …But the primacy of imagination extends far beyond the scope of direct personal relationships.[6]

The following quote from the last few pages of Dewey's *Art as Experience* is as applicable in understanding the values of connection between art and technology today as it was when he wrote it:

> Morals are assigned a special compartment in theory and practice because they reflect the divisions embodied in economic and political institutions. Whenever social divisions and barriers exist, practices and ideas that correspond to them fix metes and bounds, so that liberal action is placed under restraint. Creative intelligence is looked upon with distrust; the innovations that are the essence of individuality are feared, and the generous impulse is put under bounds not to disturb the peace. Were art an acknowledged power in human association and not treated as the pleasuring of an idle moment or as a means of ostentatious display, and were morals understood to be identical with every aspect of value that is shared in experience, the "problem" of the relation of art and morals would not exist.[6]

In our involvement with computer technology, imagination, as it is described by Dewey, is, more than in any area of human activity right now, more at work and at the same time, more at risk. If we extrapolate to the rest of the world the kind of divisions and barriers that still exist in a conference exemplified by its crossing of boundaries, we may visualize the enormous obstacles still existing. The artworks included in this exhibit, and many that are not, are examples of the power of imagination to bridge various areas of human endeavor, as well as to construct those bridges with goals of "generous impulse".

Misunderstanding both the depth and breadth that a felt sense of tangible possibilities plays in nurturing the kinds of art that make a difference in the world is common enough across disciplines. Neither scientists, artists, educators, nor philosophers need to bear the burden of blame alone. We all share it equally. The kind of raw physically felt sense of potential that encourages me to continue across the bridge despite the oppression of a 20-year-old dream also allows me to sense the incredible wisdom I might gain from that dream about the bridge, if only I permit myself to imagine it.

Acknowledgments

I am grateful to Matthew Lewis for his helpful and perceptive suggestions concerning this essay, and to Jean Ippolito for her choice of the exhibit's title.

References

1 Berleant, A. Art and Engagement.Temple University Press,1984.

2 Bergson, H. An Introduction to Metaphysics. Bobbs-Merill, 1955.

3 Dewey, J. Art as Experience. Minton, Blach & Company, 1934.

4 Dewey, J. Art as Experience. Minton, Blach & Company, 1934, p.267-268.

5 Dewey, J. Art as Experience. Minton, Blach & Company, 1934, p.319-320.

6 Dewey, J. Art as Experience. Minton, Blach & Company, 1934, p.348- 349.

7 Merleau-Ponty, M. The Primacy of Perception. Northwestern University Press, 1964.

8 Midgley, M. Wisdom, Information and Wonder. Routledge, 1989.

9 West, C. The American Evasion of Philosophy. University of Wisconsin Press, 1989, p.71.

CAROL GIGLIOTTI
Department of Art Education and Advanced Computing Center for the Arts and Design

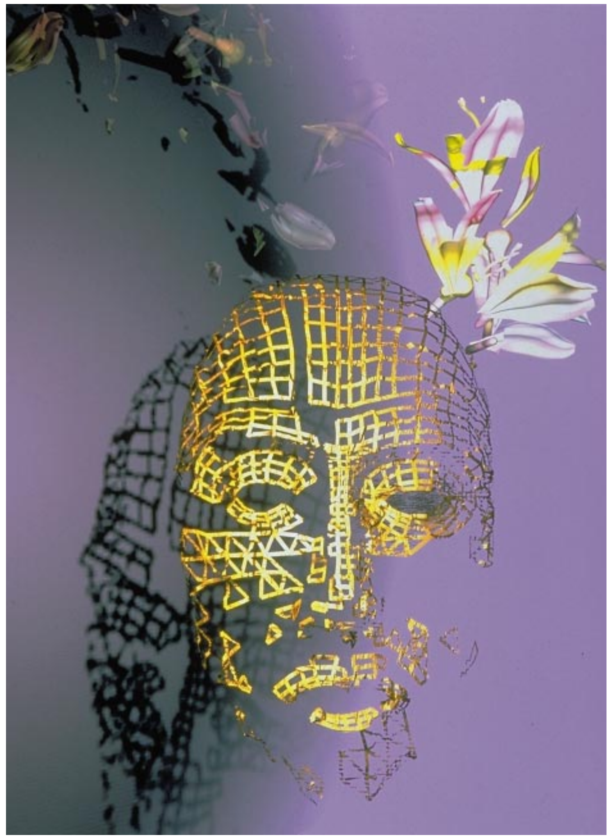
The Ohio State University
340 Hopkins Hall
Columbus, Ohio 43212 USA
+1.614.292.0235
+1.614.688.4483
carol@cgrg.ohio-state.edu

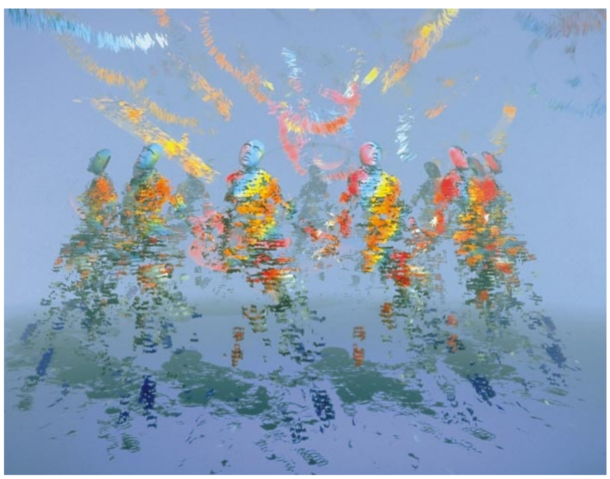
Computer art based on mathematical definitions of objects and strategies force the artist towards a deadly and plastic concept of reality. How does an artist using this process avoid the cold and sterile and achieve a semblance of spontaneity? I have found that one needs to develop a sense of the ridiculous to overcome such perfection. If you truly play in parameter space or do it wrong, the results are usually more interesting.

Pan the Greek God of Mischief lives in my computer, which I named Stupid. My interest in using a computer's capability to exploit new notions about creativity are very intriguing to Pan. At the same time, he takes great pleasure in tormenting me and causing mistakes so that I become confused and question my involvement with a computer. We have an interesting relationship: he deliberately corrupts my parameters and presents me with what he thinks are horrible pictures. Most of the time this is true, but occasionally Pan makes a mistake and I get back an amazing image. It is something I would never have predicted, and then I claim it as my own personal work. When this happens, he becomes furious, and his evil side comes out and shuts down the computer. Eventually, Pan will relent because he really enjoys playing this game with me. After all, he wins most of the time. And I have to admit that I do love Pan's playful attitude about art and computers.

I must constantly remind myself that as an artist my role is to build psychological bridges linking together feelings and shared human experiences. My use of fragmentation is symbolic of chaos or of partial objects and blunted feelings. These bridges must support my effort to express my inner thoughts and feelings about the human spirit. The goal is to achieve a balance between technology and an esthetic domain to make a meaningful artistic statement.

As I write these words of wisdom, I notice that Pan is yawning. He is very bored with the notion of art and computers. He has learned all of this before from so many artists. Apparently there are certain key phrases that simply put him to sleep. However, when I succeed in crossing one of my bridges, Pan becomes confused and forgets to be my nemesis.





Contact
CHARLES CSURI
Advanced Computing Center for the Arts and Design
The Ohio State University
1224 Kinnear Road
Columbus, Ohio 43212 USA
csuri@cgrg.ohio-state.edu
http://www.zdepth.com/horizons/csuri

InterFace is a work that seeks to examine the role of perception on three primary fronts (Art, Education, and Science) by establishing metaphorical environments or settings, each of which is representative of one of these three categories.

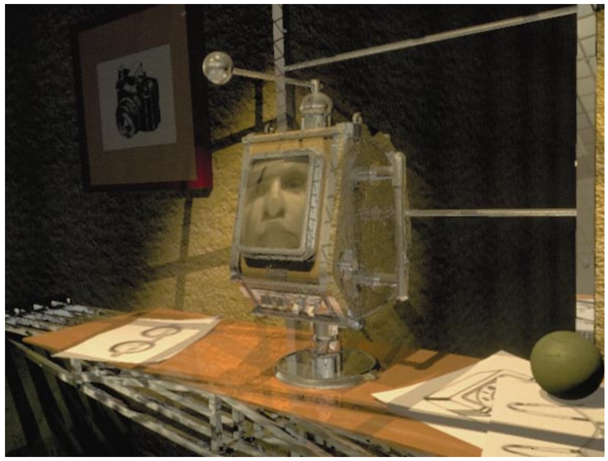
The Art environment consists of a large rock with a face carved into its front, which swings pendulum-like from a crude wooden structure in the middle of a dark cavern. The Education environment is comprised of a blackboard that sits next to a paddle on a shelf in a small, paneled room. On the surface of the board is a chalk drawing of a face, which mutely addresses the viewer. The Science environment is portrayed by a dated video unit with a flickering face on its screen. A spinning rotor causes the entire monitor to wobble slightly.

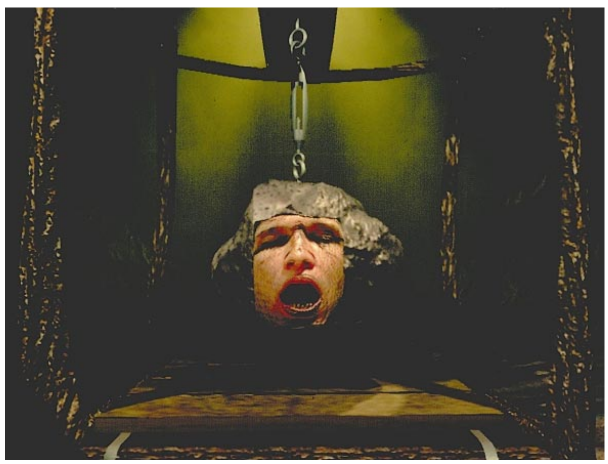
Each environment represents one of the three major phases in human communications: carving, writing, and electronics. The nature of the settings also provides a tongue-in-cheek commentary on the less flattering aspects of these fields: the Art environment is portrayed as primitive and isolated. The Education environment appears restrictive and ominous. And the Science environment is “buggy” and obsolete.

Each of the three settings in InterFace is accompanied by a series of images and dates that bear significance in the history of perception for that particular field. The images and textual passages are interspersed among footage of the environments to create a cyclical montage with no clear beginning or ending, only a continual evolution and retrenchment. Through the medium of computer graphics, InterFace seeks to integrate the very fields it portrays with its own combination of Art, Education, and Science.

Contact
KEVIN GEIGER AND
MOON HWA SEUN

7097 Alvern Street #D319
Los Angeles, California 90045 USA
+1.310.649.5491
nutball@cinenet.net





This installation began as a special project for the Mozart Museum in the Figaro House in Vienna. For most of the visitors to the Mozart Museum's standing exhibition, the sketches for scores, although they are originals, tend to be less interesting than the letters and notes Mozart penned, for the simple reason that the contents of the musical scores remain inaccessible to people who cannot read them. This installation helps museum visitors move beyond simply viewing Mozart's notes to a full experience of his music.

The work consists of a pedestal with an analog-capacitive glass surface. Behind the glass, an original musical score for *Piano Fugue, Opus 154*, is exhibited in the usual picture frame. When a visitor touches a note on the sketched musical score, a sequencer specially developed for this installation generates the corresponding musical note.

In this manner, visitors are able to follow the musical score with their fingers and play the piece of music. The speed at which their fingers move across the score determines the speed at which the music is reproduced.

Contact
CHRISTIAN MÖLLER

University of Art and Design
Meisengasse 28
60313 Frankfurt, GERMANY
moelchr@pop-frankfurt.com

Programming
CHRISTIAN GUSENBAUER

Pianists
WERNER EDER
ERNST KRONSTEINER

Sponsor
GOETHE INSTITUT HOUSTON

The Third Dimension of "Ritratto di Gentiluomo"

This installation, the product of a collaboration with the Italian scholar Maurizio Seracini, focuses on visualizing the different layers of *Ritratto di Gentiluomo*. Through X-ray and infrared technology, the otherwise invisible sketches and grounding behind the surface of the painting are made visible.

The visualization system used in the SIGGRAPH 96 art show relies on an enormous touch screen specially developed for this purpose. As far as we know, the system, developed in England, is the largest analog-resistive touch screen available worldwide.

Using a high-resolution data projector, *Ritratto di Gentiluomo* is back-projected onto the touch screen at its original size, so visitors see it as a virtual replica of the original. By touching the screen, visitors can erase one layer of painting after another. They can proceed backward in time through the layers of the painting or "paint back in" some of the areas in the painting that have been "erased".

Viewers navigate their way through the third dimension of the picture and create a seamless and unique pictorial collage of a major work of 16th-century art, without adding anything to it that was not already present in the original.

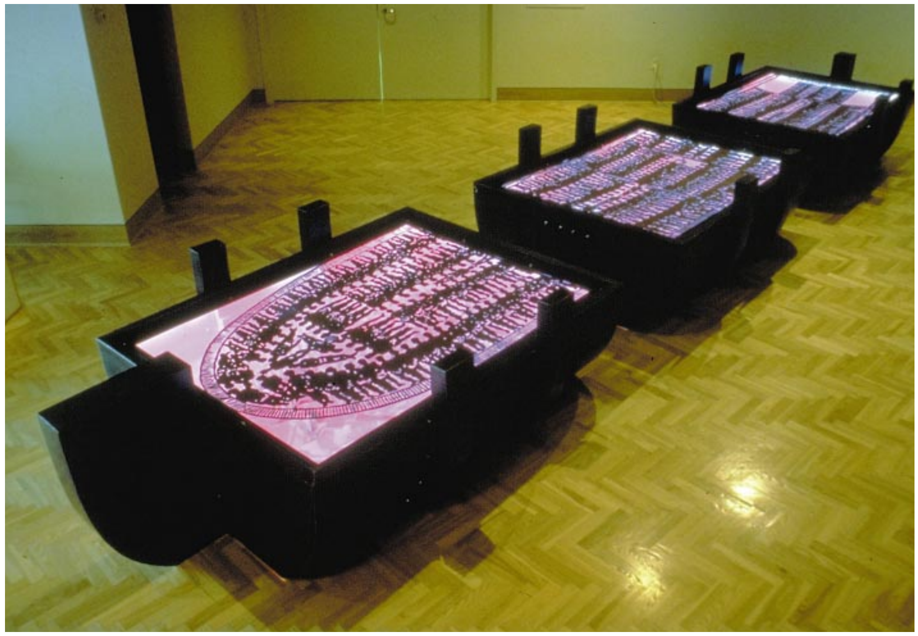
Contact
CHRISTIAN MÖLLER

University of Art and Design
Meisengasse 28
60313 Frankfurt, GERMANY
moelchr@pop-frankfurt.com

Programming
EDITH SPIEGL

On loan from
J. E. WEIDINGER

Sponsors
GOETHE INSTITUT HOUSTON
GERMAN CULTURAL CENTER



The notions of process, creative exploration, realization of form, and how we bridge the gap between objects created in the virtual environment and the real world are issues that I address in my work as an artist using computers. My artwork serves as a bridge through which I can reconcile and communicate collective cultural ideals. These ideals are expressed as objects or installations that have relevance and significance on a variety of levels to the society in which they exist. As a result, most of my work is conceptually based. Once a concept has been defined, I seek out and utilize whatever media and means facilitate the realization of my ideas.

Within the context of my work, computer graphics technologies are used to facilitate the conceptualization of ideas. In this regard, I view myself as an artist who uses computers and not as a computer artist, since the concepts behind the work determine the technologies that are used to bring them into being. Having worked in a wide variety of computer graphics technologies while developing sculptural works that can stand on their own, I have begun to bridge the gap between the object itself and its formative process. *Middle Passage* exemplifies this approach.

This is a pivotal work in my development. Thematically, the piece was created in the spirit of "Sankofa," an Akan word that means "go back and fetch it". On another level, it embodies the importance of going back to retrieve your past in order to prepare to step into the future, bridging the gap between past, present, and future.

The Atlantic Ocean provides the impetus for many people's mythology and history. For African-Americans, the ocean serves as an unmarked grave for six million Africans who died on slave ships traveling from Africa to the Americas. This middle passage marks a brutalizing rite of passage for African-Americans, whose ancestors both survived and perished in their forced journey across the waters.

Middle Passage is a 9.5-foot steel rendition. It displays a symbiotic relationship between my work in sculpture and computer graphics. Starting as a series of still images and then as an animation short using image-processing software, I began to conceive of it as a sculptural form. Using a paint package, 3D modeling, and image-processing software, I was able to create the model for the finished piece.

Contact
ANDREW SCOTT

580 Town Street
Apartment 332
Columbus, Ohio 43215 USA
andrew@grumpy.cgrg.ohio-state.edu

The Meadow explores and manifests the metaphorical space that lies between the simulated and the real — a space to which artists are inevitably drawn. Ambiguity and irony also share this space, and it is here that new mythologies and realities may be imagined. This space is particularly appropriate to artists working with new electronic technologies to bridge the gap between science and fiction.

Stepping into the installation space, the visitor is surrounded by four large color monitors, each displaying real-time, full-motion video of a different view of a meadow as seen from a central vantage point. It is winter in the meadow, then suddenly the season shifts. The views remain the same, but a certain motion or sequence of movements has triggered a transformation. Suddenly, it is spring. The visitor discovers, moving within the installation space, how to trigger these seasonal changes and finds it is possible to move backward in time, from winter to fall, or across seasons, from fall to spring.

Other effects may also be triggered: the sound of a flock of geese, which suddenly materializes, flies overhead, and disappears; the persistent and annoying buzz of a mosquito; children laughing or playing just out of sight. A child whispers on your left and is answered by another child whispering on your right. A momentary freezing or speeding up of the video imagery, a sudden change of perspective or shifting of location, may seem to be random. As in real life, the relationship between cause and effect is sometimes blurred.

Ultrasonic transducers, a centralized microprocessor unit, and a custom-designed micro-controller for four laserdisc players engage the visitor in an interactive simulation of a small, intimate meadow. The microprocessor and controller perform two functions: detection of visitor location/movement and multiple laserdisc control.

Contact
NANCY PATERSON

475 The West Mall #1513
Etobicoke, Ontario M9C 4Z3
CANADA
nancy@utcc.utoronto.ca

Technical Support
POLAROID
PIONEER
3M

Financial Support
CANADA COUNCIL
ONTARIO ARTS COUNCIL

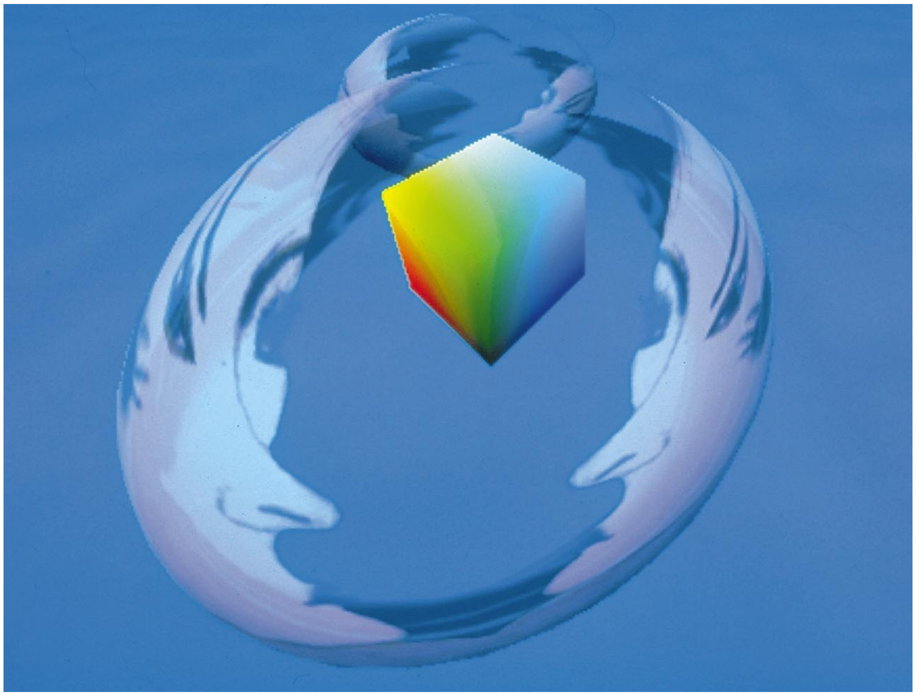
Virtual reality creates environments where the meaning resides primarily in its immersive and interactive qualities. These interactive works engage the viewer in experiences that break the traditional boundaries of art, by actively involving participants in a series of visually compelling environments. They extend the traditional arts by encouraging the viewer to actively participate in the creative process.

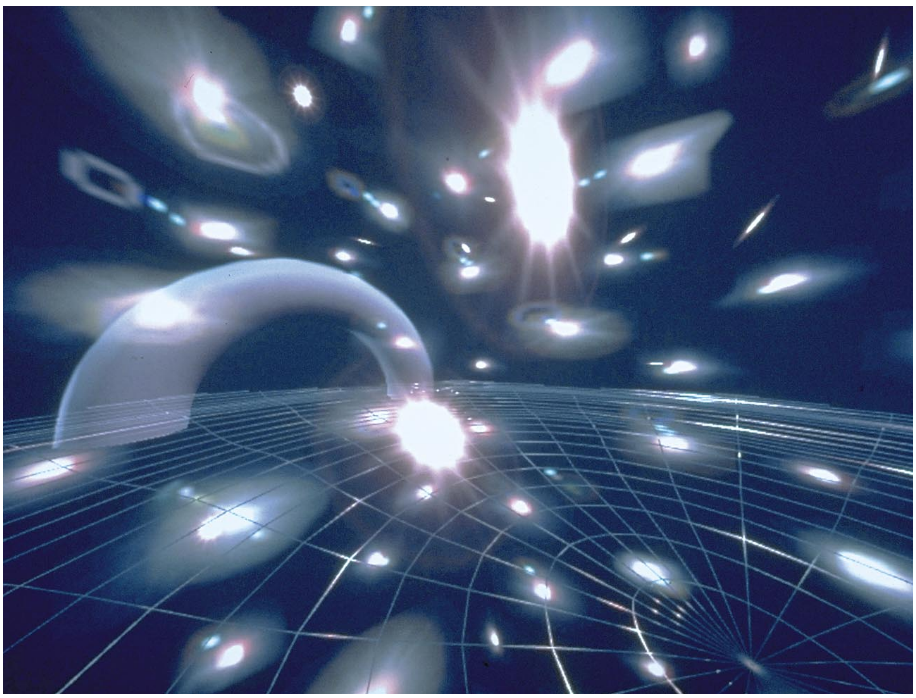
In this work, virtual reality becomes accessible to digital artists through the ImmersaDesk, a projection-based, drafting-table-sized virtual reality system. The size and position of the screen give a sufficiently large wide-angle view that the viewer feels fully immersed in the visual scene. Head tracking allows the participant to experience a first-person view as opposed to the third-person view that is experienced with other visual media. The hand position is tracked by the "wand", the main device with which participants can manipulate the scene. Additionally, the area around the desk is surrounded by a directional sound system.

The physical installation of the ImmersaDesk creates an evocative setting for viewers to experience and participate in the worlds that unfold before them. It merges aesthetic and conceptual concerns with high-resolution display technology, network connectivity, and advanced visualization techniques. Moreover, participants at remote sites have the opportunity to explore the same worlds and interact with each other.

Neither Here Nor There is a series of collaborative events utilizing advanced networking, software and hardware to interconnect the Immersadesk environments in The Bridge: SIGGRAPH 96 Art Show, an Immersadesk installed in the Digital Bayou, and a CAVE™ at the Ars Electronica Center in Linz, Austria. The title of this collaboration reflects the ethereal status of cybercommunication in current society. It also characterizes the notion that while on a bridge you are between locations. It is a state of being that is time-based, where geographic location (space) is irrelevant.

These virtual reality environments create a new form of communication that offers a presence not ever experienced in traditional forms of communication. By digitally connecting to other VR platforms, users experience the potential of networked interactivity. The use of interactive applications opens a window into the probable future of high-end telecommunications. The fusion of disciplines is the basis for this unique collaborative effort. In this model, technology and art collaborate to create highly interactive and immersive virtual environments.





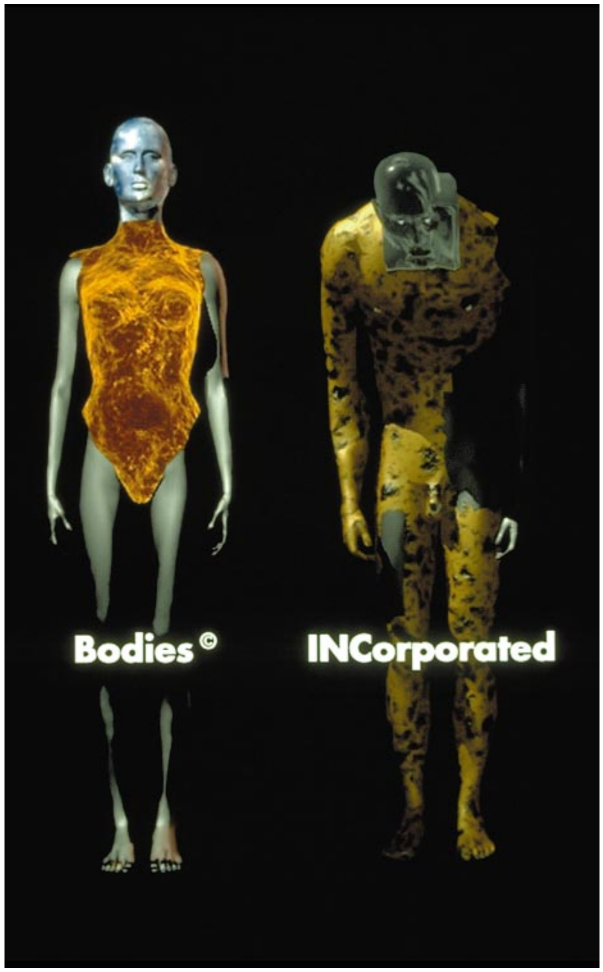
Contact
DANIEL J. SANDIN
Electronic Visualization Laboratory

University of Illinois at Chicago
851 South Morgan Street
Room 1120
Chicago, Illinois 60607 USA
dan@evl.eecs.uic.edu

Participating Artists

JIM BARR
BOR-TYNG LIN
KEITH BEU
GARY LINDAHL
JEFFERY BROOKS
DEBRA LOWMAN-MELCHIONDA
DREW BROWNING
ERAN MILLER
ORLANDO CARNATE
ALAN MILLMAN
TOM COFFIN
DAVE PAPE
ALAN CRUZ
KYOUNG PARK
MAREK CZERNUSZENKO
SO YEN PARK
GREG DAWE
CLAIRE PRUCHER
MARGARET DOLINSKY
MAGGIE RAWLINGS
TERRY FRANGUIADAKIS
JOE REITZER
ROBERT GRZESZCZUK
MARIA ROUSSOS
YUN-WEN HSU
DAN SANDIN
MILANA HUANG
GRIT SEHMISCH
JOE INSLEY
VINCENT SHINE
KA LEUNG JARK
MARCUS THIEBAUX
ANDREW JOHNSON
BOVORNPOL THIENSIRI
LOUIS KAUFFMAN
SELENA TRAMAYNE
JOHNNY LAWSON
CHRISTINA A. VASILAKIS
JASON LEIGH
MARGARET WATSON

Bodies© INCorporated., a public space on the Web, occasionally emerges as a physical environment. In the summer of 1996, it appears simultaneously at the San Francisco Art Institute, SIGGRAPH 96, and the Contemporary Arts Center in New Orleans. The work is comprised of three main public sites, where different sets of activities and emotional dynamics occur. The first is "Limbo," a gray, frustrating, rather static and non-descript zone, where information can be accessed about bodies that have been put on hold by owners who have abandoned or neglected them. The second is the "Necropolis," a richly textured, baroque setting that produces feelings of anxiety, fear, and exhilaration, where owners choose from a seemingly endless list of disturbing possibilities for how they wish their bodies to die. The third is the "Exhibition/ Body Building" space, a "gallery" domain where bodies are displayed and visitors can actively reassemble their "virtual others."



Events in each of the three territories ignite a range of emotional responses and raise a variety of interesting issues related to online community dynamics. For example, when the body is "killed," it is announced to the collection of "body owners" via email and made into a public spectacle. The implications of the actual person being identified in the public space have the potential to radically change the community dynamic. When bodies are exhibited over the Internet, quite obviously, they reach a much larger audience than in a public space like a museum. But once they are in a physical space, the owners tend to take their exhibition much more seriously and any kind of public event much more personally.

There is an odd sense of complexity in the murder of a thought-creation made public. How does the graphic representation of the body amplify our relationship to it? What sort of psychological commitment and attachment do owners exhibit toward their "virtual" bodies? What happens when you discover that your body has been publicly altered in some way, without your knowledge or participation? How does the body become a source of pleasure and anxiety as it moves through changes and permutations that are outside the owner's control? What sort of emotional dynamics result from bodies being displayed as a public spectacle? These are just a few questions being raised in *Bodies© INCorporated*. Perhaps you will have a few of your own.

Contact
VICTORIA VESNA
Department of Art Studio

University of California at Santa Barbara
Santa Barbara, California 93106 USA
vesna@humanities.ucsb.edu

Collaborators

ROBERT NIDEFFER
http://www.arts.ucsb.edu/~nideffer
nideffer@alishaw.ucsb.edu

JASON SCHLEIFER
http://www.arts.ucsb.edu/~schmuck
ujsch@mcl.mcl.ucsb.edu

KENNETH FIELDS
http://www.ccmrc.ucsb.edu/~fields
ken@ccmrc.ucsb.edu

NATHANIAL FREITAS
http://www.ccmrc.ucsb.edu/~nathan
nathan@ccmrc.ucsb.edu

Intro Act & MIC Exploration Space

Free access to virtual space needs to be improved and facilitated by enabling real-time integration of human participants into a 3D environment. With this in mind, Christa Sommerer and Laurent Mignonneau designed *MIC Exploration Space*, a virtual environment that allows users to enter into two different rooms and virtually interact with each other in real time. The place functions as a new form of integration; development pictures, artificial life, and artistic features create an evolving environment, one that reflects the participants' personalities and their inter-actions with one another.

MIC also emphasizes communication between remotely located participants who share the same virtual environment. Real-time feedback and unencumbered interaction are essential when designing such a space. Mignonneau's 3D Key System allows the participants to interact freely, with no devices attached to their bodies. A camera detection system tracks visitors' gestures and motion and interprets them in real time as characteristic features in the evolving environment. This enables each visitor to create a unique environment that interprets his or her actions with the other user. Evolutionary graphic processes create an open-ended environment that is not predetermined but able to evolve over time.

Contact
CHRISTA SOMMERER
LAURENT MIGNONNEAU

ATR Media Integration &
Communications Research Lab
2-2 Hikaridai, Seika-cho, Soraku gun
619-02 Kyoto, JAPAN
christa@mic.atr.co.jp
laurent@mic.atr.co.jp
http://www.mic..atr.co.jp/~christa

Supported by
Commande de l'Etat français
Ministere de la Culture

Masturbatory Interactant is a computer-interactive electromechanical installation that is the ultimate realization of several years of conceptualization and creative interest in critically examining the human/machine interface. The work is a synthesis of concepts and processes related to post-modernism, feminism, neo-Luddism, and art history. The installation is directly influenced by Marcel Duchamp's seminal work of mechanized eroticism: *The Bride Stripped Bare by Her Bachelors, Even (The Large Glass)*, 1915-23.

Masturbatory Interactant incorporates a bar-code-activated Macintosh computer, an LCD video projector, and kinetic electromechanical sculptural elements. Duchamp's bride has become an inflatable female party doll, painted white and continuously suspended inside a transparent enclosure by the air flow of three 20" cooling fans. The floating female form acts as a projection surface for randomly selected computer-based visual information — essentially a hyperkinetic image stream primarily consisting of a combination of short, provocative QuickTime video segments of digitized close-ups of a nude male figure conducting self-erotic actions, 3D computer animations of the "bachelors" from Duchamp's piece, text, and audio.

The imagery is selected randomly through an automated interactive process. The "chocolate grinder" from Duchamp's piece has become a kinetic sculpture whose tapered drums are covered with bar codes, slowly rotating around the central axis. All the while, the bar-code scanner, a pen-like device mounted on an extending and retracting armature, randomly scans the bar codes. The scanned bar codes send predefined commands to a Macintosh computer mounted above the grinder, which chooses image segments from a Macromedia Director-based multimedia program. The selected images are then projected onto the floating body by an LCD video projector, the third element of the "chocolate grinder" mechanism, attached at the top of the structure.

This installation creates an absurd incident, in which the visitor, the so-called "empowered"

Contact
JOSEPH DELAPPE

University of Nevada, Reno
Department of Art/224
Reno, Nevada 89557 USA
delappe@scs.unr.edu

user of interactive machines, becomes a passive, voyeuristic spectator of a device whose sole purpose is to interact with itself; hence the title, *Masturbatory Interactant*. This piece critically investigates male sexuality, technological hegemony, and multimedia hyperbole through humor, high-tech absurdity, and non-participatory computer interaction.

The doll, a pathetic idealization of the female form designed for pure male fantasy and control, becomes an active matrix for the critical exposure of male power and desire. The intent is to transform what might be a purely insulting object into a metaphorical carrier of feminist ideas. The actual structure of the female body form, mass-produced from primitive sections of cut and assembled vinyl, suggests connections to the design of 3D-modeled virtual bodies in cybersex fantasies. The automated selection and projection of imagery, combined with the frenetically moving projection surface, creates a viewing experience that is difficult to grasp for more than a fleeting instant. The non-linear, digitally-processed image flow creates a temporal, fluid, and ultimately post-modern experience of randomly chosen visual information.

In part, the piece serves as a critique of contemporary high technology, particularly through the use of an intentionally non-interactive bar code process by which the piece functions, creating an incident for the consideration of information, consumption, access, privilege, and power in the information age.

Life Journey is an interactive installation that confronts visitors with the confinement imposed by a wheelchair. The piece contrasts the immobility of the visitor, sitting motionless in a chair (which is attached to the floor) with the illusion of high-speed travel, created by visual projections on both sides of the user. Accompanying the visuals are sounds of highway traffic and the force of simulated wind.

The media employed to create the installation include a video component, a motorized wheelchair, and other mechanical and electrical elements. To explore the installation, a visitor enters a dark space with a single illuminated wheelchair in the center. As the visitor sits in the chair, the wheels begin to spin, and video projectors suspended from the ceiling on either side of the chair are activated, as is an industrial fan located directly in front of the chair. The projected visual images consist of 70-mile-per-hour traffic, accompanied by appropriate sounds. This vicarious "journey" continues as long as the visitor remains seated. The environment simulates the sensation of whirling through the wind like an automobile.

Life Journey gives the visitor the ability to move virtually from one space to another with the understanding that individuals who live with a wheelchair have limited mobility in parts of their bodies. While the visitor remains seated, the wheelchair becomes a contradiction of motion. This juxtaposition of mobility with immobility heightens the awareness of the loss of control that one feels when confined.

Contact
JON BERGE
Advanced Computing Center for the Arts and Design

The Ohio State University
753 Oak Street
Columbus, Ohio 43205 USA
jberge@cgrg.ohio-state.edu

Electrical Engineer
MARK YANNITELL

Design Engineer
CHRIS YOCULAN

Video Engineer
MICHELE LACH

C*ome in…* is an interactive installation that involves video, audio, animation, and interactive work combined into one piece. It is my visualization of "how art should be experienced by the viewer." The person who is experiencing it should be separated from the outside environment as much as possible. The viewer should have a complete experience of the work and should also experience the process that goes into making that work. The process of creating art is as important as the final art piece.

With the rapid commercialization of computer graphics, many artists were seduced by the finesse of technology. Their only concern was to attain the final product. The process was not as important, and most of the time the viewer did not even realize that there was a process behind the final product. I believe that this approach to computer art is wrong. We should not be the followers. We should do our art and let everybody experience it, both the product and the process. Viewers should experience the art in a way that makes them think of new ideas that will be realized as new pieces of artwork, which will in turn enable somebody else to generate some other ideas that will eventually lead toward the complete satisfaction of all of our senses. The process of creating artwork and experiencing it (listening, seeing, or touching) should not be separated, and there should be a more tangible connection (the bridge) between the artist and the viewer. That bridge should be two-sided, and ideas should be transferred in both directions. The artist should influence the viewer's way of experiencing the artwork, and, at the same time, the viewer should experience the artist's process of creating the artwork.

The process of creation is a significant part of us, and we should not hide it. We have to work with the process, experience it, get ideas out of it, and let others be a part of our process, to let them experience it so they can keep the process going.

There are four major parts of the installation. All four of them occur simultaneously and function as a whole.

1 Audio

I often use audio as a stimulation and inspiration for my animations, stills, and interactive work. It is not just music. It also includes noises from the street, noises from my neighbors' apartments, the sound of the bells of Savannah churches, voices of my friends. In order to experience the complete idea behind this project, the viewer must experience me as an artist, so I use sounds from Croatia (my home) blended in with the rest of the audio.

2 The walls

The two monitors and audio speakers are installed within a fairly small space: 4 feet x 4 feet x 7 feet. The walls that define this space also separate the audience from the rest of the environment and put the viewer into "my" space. The walls (inside and outside the installation) are covered with my sketches, written ideas, and some finished drawings that came out of the process of creating this piece and previous pieces. Some of those are ideas that are not directly connected with the process of creating, but they influence the process indirectly. One of the strongest is the war in my home country and the idea that I will be part of it in the fall of 1996. Even when I try to avoid it, I can't, so I don't even try anymore.

3 Video/animation

Like the previous two parts, the videotape describes a lot of things that go into making my artwork. It shows the process. The video monitor is mounted on top of the wall construction, and it and the computer monitor provide the only sources of light with the installation.

4 Interactive program

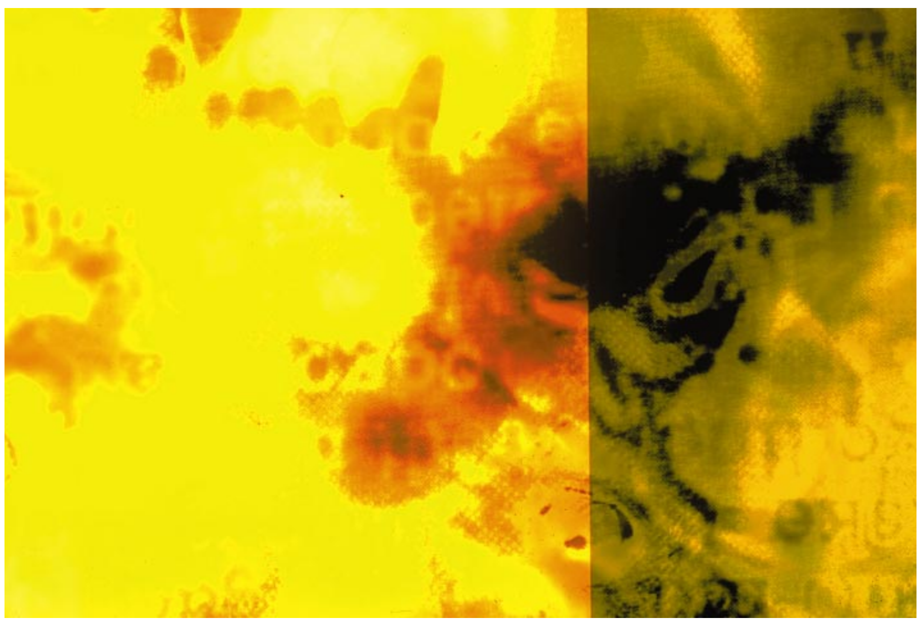
Since the process is the most important part of the installation, the final product – the interactive program – is just a combination of all of those "process" ideas.

The program runs on a Pentium PC with two controllers and two monitors, so a viewer outside the installation and a user within the walls interact with the computer simultaneously, and with each other. The computer is a bridge between these two people.

Actions of one user influence (distort) actions of the other. The program also functions when there is only one user exploring, on either the inside or the outside of the installation. In this case, the user's moves are interacting with logic built into the code of the program. The person inside has the complete experience of the installation, while the person outside has just a part of it.

Users experience the program by moving through a combination of 2D and 3D space and creating interesting visual compositions. The whole program is based on eight stories that are happening simultaneously inside of me. The stories are created by multiple images (also part of the video and the walls) presented on the screen as the user moves the controlling devices. On the basis of the user's behavior (fast, slow, multiple changes of direction, what kind of drawing the user does on the screen), the program chooses what picture to present next. The pictures that are presented to the viewer do not necessarily continue the same story, because the program makes decisions (also based on the user's behavior) to jump from story to story. The movement of the pointer on the screen is controlled by both users, but the movement on the screen need not be oriented to the movement of the control devices, so if one, or both, users move the control device toward the right, the program might move the pointer toward the left, based on the previous behavior of the user.

The interactive program is written in Borland C++ and uses SVGA graphics.



Contact
ANTE MAGZAN

Savannah College of Art and Design
Drayton Tower Apartment 501
Savannah, Georgia 31401 USA
croante@aol.com

Bumper stickers have always been one of my favorite forms of public art. Perhaps sensing that the road to the mall may be all that is left of our public space, Americans choose to respond to the endless commercial messages we receive with our own messages to the public. And we hold nothing back. Whether collecting the most toys, getting to heaven, or fighting for the child, the choice, the life, or the power, we are putting our personal gospel on the road. The pet peeves, politics, humor, and humorlessness stuck to our bumpers provide a view into our collective unconscious, exposing anxieties about class and race and a longing for transcendence in an environment that often offers nothing but endless vistas of advertising and consumerism.

why a hip information surge	fair net highway minus poor	whip his funny marriage too	four whip right mayonnaise	aspirin or tofu highway men
wispy fog ah human interior	finish wary home purgation	peg who if horny sanitarium	if animator why rough penis	net fashion group airy whim
hip	nery	hush imaginary power of tin	armies of guano hip thin wry	why aspirin if megaton hour
imp	war	if highwaymen tour a prison	whisper hint if amour agony	whip our mayonnaise fright
min	heirs	fiery inhuman goat worship	we fashion utopia myrrh gin	surf a highway premonition
inhu	hour	younger fish whip animator	his power imaginary hot fun	horny utopia win harem gifs
i hu	yogi	fuming pariah nosy hot wire	army fashioning hot wireup	oh thy paragon firm i sue win
why	wife	why a hip information surge	fair net highway minus poor	whip his funny marriage too
hig	pain	wispy fog ah human interior	finish wary home purgation	peg who if horny sanitarium
hun	rints	hip hu	g winery	hush imaginary power of tin
aim	nity	impiou	gin war	if highwaymen tour a prison
nau	way	minist	ian heirs	fiery inhuman goat worship
wri	high	inhuman worship a toy grief	fishy aroma newt in pig hour	younger fish whip animator
why	wit	i hurry wish of megaton pain	how far pristine human yogi	fuming pariah nosy hot wire
feig	nnia	why no fish grim utopian era	must gain hip honorary wife	why a hip information surge
who	iring	highway remains unfit poor	your nightmare wish of pain	wispy fog ah human interior
why hamper ruination of sgi	i rap of nitrous highwaymen	humor fashioning weary pit	ah you who aim fingerprints	hip human iris oft gone awry
fishy aroma newt hi up groin	oh hairy springtime faun ow	aim tough finish army power	era of worshiping humanity	impious rhythm wagon afire
if hip authors among winery	nation's whim pay for hi urge	naughty hormone if i sip war	amino surf protein highway	ministry of power again huh
why fear tin magi i shun poor	why tap inharmonious grief	writhe of union pariah gyms	powers of my unitarian high	inhuman worship a toy grief
four whip right mayonnaise	aspirin or tofu highway men	why i push animation forger	onrushing foe my pariah wit	i hurry wish of megaton pain
if animator why rough penis	net fashion group airy whim	feign a whip human sorority	pure highway fort insomnia	why no fish grim utopian
armies of guano hip thin wry	why aspirin if megaton hour	who am i if gryphon urinates	animators foe why up hiring	era why a hip information
whisper hint if amour agony	whip our mayonnaise fright	why hamper ruination of sgi	i rap of nitrous highwaymen	surgewispy fog ah human
we fashion utopia myrrh gin	surf a highway premonition	fishy aroma newt hi up groin	oh hairy springtime faun ow	interiorhip human iris oft
his power imaginary hot fun	horny utopia win harem gifs	if hip authors among winery	nation's whim pay for hi urge	gone awryimpious rhythm
army fashioning hot wireup	oh thy paragon firm i sue win	why fear tin magi i shun poor	why tap inharmonious grief	wagon afire ministry of

Which is not to claim that bumper stickers often live up to their potential. Consumers express themselves primarily in the selection of prepackaged statements of blinding obviousness. Individuality, paradoxically, becomes an act of choosing someone else's words, and often, words that are already cliché. The act of sticking a currently popular quotation on one's automobile simultaneously asserts individuality and claims membership in a smaller group. This same analysis, of course, applies to any consumer product and should not be lost on new car buyers, many of whom, I notice, loathe bumper stickers.

I have chosen as my project the anagramatic decoding of the phrase "Information Superhighway." It seems appropriate to try to merge the current mythology of the information superhighway onto the real superhighway, an artifact of an earlier era also invested with techno-utopian expectations. The interstate highway system now seems both more popular and more benign than contemporaneous artifacts like nuclear power, the cold war, and television. Residents of cities, however, can attest to the interstate's role in dividing communities, facilitating social control, fueling suburban sprawl and environmental degradation.

Creating anagrams illustrates some essential differences in the ways humans and computers handle computational tasks. On one hand, the phrases in my bumper stickers may be seen as absolutely meaningless, having been produced by a computer that rearranges letters and searches lists at blinding speed but without any understanding of nouns, verbs, or adjectives. Humans, on the other hand, cannot match the precision or speed of the computer's search, yet they easily negotiate a complex matrix of ambiguous and indefinite meanings that function simultaneously on many levels.

The actual procedure involves letting the computer quickly (or autonomously) produce huge files of anagrams and then manually attempting to parse likely combinations of words in what is analogous to writing poetry in a very cramped space. Writing may be the wrong term here, because the combinations already exist and one really only "discovers" them. I like to think that the forces responsible for promoting the phrase "Information Superhighway" were also responding, only subliminally, to alternate readings like "pure highway fort somnia" and "why aspirin if megaton hour." I take a perverse enjoyment in this search for esonant phrases, although it is often mind numbing, inhuman activity. This leads me to empathize, I hope, with workers in white-collar sweatshops who enter and process the meaningless data that control flows of money, goods, and power, and with the real code breakers at the National Security Agency whose top-secret/black-budget snooping on just about everyone shows no sign of abating any time soon.[1]

There is also a delight in considering the recontextualization of the messages as they travel from the algorithmic, math-rich environment at SIGGRAPH to the salt- and rust-covered bumpers of the Midwest; the multilingual bumpers of San Diego, San Antonio, and Miami; or the fully depreciated bumpers of temporary workers plying the streets of soulless silicon gold rush burbs in tech town USA.

Contact
PAUL BADGER

Brown University
Box 1861 List Hall
Providence, Rhode Island 02912 USA
+1.401.863.3381
Paul_Badger@brown.edu

1 For a discussion of the use of anagrams in cryptography see David Kahn, The Codebreakers: The Story of Secret Writing, New York: MacMillan, 1967. For a dated but still fascinating account of what is reputed to be the largest computer center on earth, see James Bamford, The Puzzle Palace: A Report on America's Most Secret Agency, Boston: Houghton Mifflin, 1982.

M*istaken Identities* is an interactive CD-ROM inspired by the lives and work of 10 famous women: Josephine Baker, Simone de Beauvoir, Catherine the Great, Colette, Marie Curie, Marlene Dietrich, Isadora Duncan, Frida Kahlo, Margaret Mead, and Gertrude Stein. It discovers bridges that link the lives of these women, using the CD-ROM format's branching structure to create parallels and overlaps among their stories. The 10 women were chosen for their emblematic status as female role models; however, the CD-ROM examines them as complex figures whose identities are not essential or fixed, but contingent and mutable. Their identities are configured in the negotiated space between self and other, a negotiation that continues in my relation to them as narrator.

Each of these women derived her power from her ability to continually reinvent herself in response to the pressures and contradictions presented by her situation. Each woman also made a substantial contribution to culture and society in fields that were not particularly open to her participation. *Mistaken Identities* constructs a genealogy around these women, observing the overlaps and parallels between their histories without undermining the specificities of each person's particular accommodation to the dilemma of how to be a woman.

The project has six sections: the Portrait Gallery, the Timeline, the Scrapbook, TV Movies, Morphologies, and the Puzzle. A variety of rhetorical tropes are utilized to present text, sound, graphics, and QuickTime movies interactively. The Portrait Gallery incorporates archival photographs in a montage format that presents the self as a series of personae assumed and discarded with the passage of time. The same photographs recur in Morphologies, but my image is morphed into the images of the other women in a virtual filmstrip format. An inventory of the generic poses utilized by painters and photographers emerges; when represented according to these conventional strategies, everyone looks similar and fictions of coherent identities are produced.

The Puzzle engages viewers as active participants by presenting them with the pieces of a jigsaw puzzle to be assembled. Each time a piece clicks into place, a QuickTime movie plays. These movies present performance tableaus, organized around the manipulation of fetishes such as lipstick, cigarettes, mirrors, kisses, playing cards, and pens. The sensuality often lacking in virtual media is reinscribed through these surrogate objects.

The boundaries between fact, fiction, and interpretation are intentionally blurred in the project. TV movies consists of clips from documentaries and Hollywood movies based on the women's lives. The viewer can channel-surf to watch these cultural artifacts that iconize their female subjects to be emulated.

In the Scrapbook, quotations from the women's autobiographical writings are juxtaposed with snapshots that convey a sense of their daily lives. A gap opens between the images and the text, complemented by authorial intervention achieved through the insertion of sound effects. These sound effects reinforce or dispel the ambiance created by the images and text to enhance polyphonic dissonances.

The multiple channels available in the CD-ROM format are also explored in the Timeline. Clip-art drawings that encapsulate milestones in the women's lives are grouped as a timeline resembling a charm bracelet. These milestone markers open up to reveal explanatory texts juxtaposed with QuickTime movies that provide commentary on the texts. The texts encompass gender blending, anachronisms, abrupt elisions in point of view, egregarious exotica, theoretical interlocutions, lyrical interludes, personal vendettas, artificial embellishments, paradoxical pastiches, and salacious lacunae. Pharmacological adventures/addictions, fashions, jewelry, perfumes, gardens, tragic accidents, nervous breakdowns, violent skirmishes, obsessive compulsions, legal transgressions, masquerades, seductions, psychic cannibalism, hysteria, bizarre domestic arrangements, lavish expenditures, eccentric eating habits, and sentimental deathbed scenes are perversely eroticized.

Contact
CHRISTINE TAMBLYN

Florida International University
Visual Arts Department dm 382
University Park Campus
Miami, Florida 33199 USA
tamblyn@ipof.fla.net

This essay describes future perspectives toward knowledge by comparing two typical inventions in history: the invention of type-setting and the invention of digitizing technology for archiving.

The continuity of knowledge is part of human evolution. Language appears to be the first medium for knowledge. It has been developed into characters, fonts, or images that help people to express knowledge or information more concretely. These vehicles of information have been collated in "books", which are the current basis of maintained knowledge. Recently, these old-fashioned vehicles for knowledge have been influenced by a new, more interactive and dynamic way of expression: the computer-networked environment. The goal of *Beyond Pages* is to present a new way of conveying knowledge that will survive into the future.

The evolution of visual reproduction in the 20th century has enhanced people's way of recognizing the world, or recognizing expression, even to the extent of creating a new paradigm. We can no longer limit ourselves to knowledge arranged in the form of books. For example, today moving images or sounds can be collated easily via digital formats. The easy-to-categorize, easy-to-edit digital environment is becoming more and more useful in our current world. Still, there are some similarities between the old "typesetting" and the new "digitizing". From this point of view, it is legitimate to understand "multimedia" more as a variant of the "book" than as a variant of a "movie".

Gutenberg's invention of type-setting was an unexpected shock in Western cultural history. It was recorded as a significant event because it deconstructed words into letters, a process that did not exist within previous cultural common sense. Essentially, the letter, prior to this, could only exist in relation to and within the flow of words or sentences. Actual type, or the deconstruction of words into individual letters, could be used repeatedly, and could be reproduced. However, the unreproducibility of meaning within certain contexts became a danger with the invention of type.

Actually, metal type was invented in Korea in the 14th century, before Gutenberg's invention, but this has never been accepted as an epoch-making event. Historians assume that this development is not celebrated because the letters were Chinese characters. Since Chinese characters are pictorial, even one type, which is the minimum element of the written language, can exist without losing its meaning. On the other hand, the Indo-European alphabet consists of phonetic characters. There is hardly any distinction between them. After all, there are only 26 letters, and each one does not possess a beauty beyond its shape. In contrast to ideographic characters, which maintain their meaning through their shape, phonetic characters, which only indicate sounds, take on a completely different meaning in type. The phonetic letter does not maintain any significance or concept except that through the strength of the writer, the human element, fragmented type is brought together as text.

Gutenberg's invention had such a dramatic impact because of the nature of the alphabet. In the end, it was more than just a technological invention. It was an event that shook the culture of knowledge itself. In other words, the revolution in printing technology in Western history was the deconstruction of voice into the minimum unit of type, making it possible to transport it to a location that voice could not ordinarily reach.

The evolution of digital media in our current age inherits this technological reformation. The basis of digital technology is the computer. In order to match all information to the data format of the computer, the subject matter must be expressed as either on or off. Fundamentally, there is no difference between this and the fact that words were deconstructed into minimum units by the invention of type. Any new medium that utilizes a computer deconstructs information, not just letters but images and sounds, with new means. The computer is used to deconstruct, reconstruct, and edit the information. The grammar and principles, however, are still undeveloped.

In this new world, neither the effort to know nor methods for learning are as developed as in the book world, where the written word and knowledge are synonymous. In order to create a starting point for these ideas, it is necessary to dismantle books in a variety of ways. What is the function of the book? First of all, there is the content of the book. Then, there is an interface to access the content, and there is a function that does not include the materiality of the book as a medium. As we eliminate the functions of the book, its materiality is revealed. The isolated object that remains is like the brain of an amnesiac. It is, however, important to look at its appearance.

The book has an all-encompassing potential. The ability to experience unbounded potential is what we call "imagination". When entirety is packed into a real book, it explodes. All at once, information creates chaos. A book becomes a book only after being edited. The editing forms the story, which can then be transmitted more efficiently. It is in a huge irreplaceable white space that the story, or content, is unfolded. The letters with their shapes are converted to sounds in the brain and regenerated.

We, however, living in our modernity, cannot read *The Divine Comedy* as Dante did, or *The Tale of Genji* as Murasaki Shikibu did. They are preserved as mere lines of letters that have lost their own context. Although content can be modified to go from medium to medium, sometimes being distributed as cassette tape and sometimes as CD-ROM, there nevertheless is a world that can only be transmitted through the feel and mass of a book. The narrative or content might stand on a fragile tightrope. The story is an incarnation of an imagination that quietly arises in the reader's brain. The action of reading is accomplished with an interface, or book. It is realized only through an important relationship with physicality and should be interactive in real time. In other words, it is a memory device so that time can be jointly owned with the reader. It is an interface that can cross from page to page, and can physically grasp a field as distance.

The book is diffusion material prepared by humans in order to connect between brains. Books are duplicated. As they are duplicated, they move around the world and are dispersed as media. The word “media”, however, has only recently begun to be widely used through an expansion of its original meaning. It is a quite recent discovery that the human body, too, is a medium for transporting knowledge.

We have been able to make our memory exist externally with media. It enables us to memorize, categorize, and retrieve events that are difficult to describe by language alone. It is a fertile land for producing a new encyclopedia, a new world map, or even a new bible. With digital media, we can go *Beyond Pages*.

Contact
MASAKI FUJIHATA
Faculty of Environmental Information

Keio University
5322 Endo, Fujisawa
Kanagawa, 252 JAPAN
masaki@sfc.keio.ac.jp

Global Interior Project is a multi-user, multi-cultural communication playground built on a networked 3D virtual environment. Visitors interact with this virtual world through one of several "Cubical-Terminals", where 3D graphic workstations are installed and connected to the server. Using a track ball to navigate the virtual world, visitors meet and talk to each other within the matrix as they access it from different locations.

Each terminal is connected to the same virtual world, so that participants sometimes run into one another as they enter from different Cubical-Terminals. While they are in the same (virtual) room, they can talk to each other over the telephone handset and see each other's faces mapped onto objects in real time.

As part of the installation, "Matrix-Cube" is a kinetic sculpture constructed as a metaphoric map of the virtual world. It represents the real world because it is a real installation. It consists of a number of boxes arranged in the form of a matrix. The individual cubes of Matrix-Cube interact with participants in virtual rooms that can be explored at each Cubical-Terminal. In short, while you are in virtual room X, the door of room X of the Matrix-Cube opens. Usually, several doors of the Matrix-Cube are open simultaneously, since each participant explores the matrix in a different way.

Each room has an object (an apple, a hat, a door knob, and so on) that indicates the room's identity. The Matrix-Cube is a visualized model of this networked virtual world that shows the activity of the virtual environment in real time. The Real World is only a map of the Virtual World, for one's virtual existence. A video image is taken of the front of the Matrix-Cube sculpture and is mapped onto one of the virtual room's walls. When participants click on a certain cube in the image of the Matrix-Cube, they jump into that particular virtual room.

By manipulating the track ball, participants propel themselves through the room to explore the objects. Each room also has four windows, one on each wall of the room. When visitors move out of a virtual window, they encounter an earth texture, a reminder of the concept of *Global Interior Project*. When they exit through a window, a warp sound is generated, and the participant location changes to another room, which contains a different object. When more than one person is in the room, they can see each other with their faces mapped onto a cubic avatar, and they can talk to each other.

With this system, participants can experience a triple-existence: one in the real world, one in the virtual world, and one in the image of the real within the virtual world. These shifting dimensions raise some intriguing questions: What is the real value of one's address or location? Which is the reality? How is one's existence supported?

Global Interior Project is an application running on InterSpace. The first prototype was made by using InterSpace as an infrastructure. It has been shown at InterCommunication 95, Spiral Garden, and P3 Gallery. The multi-ISDN-port InterSpace server is running at NTT Software Corporation's San Francisco branch. Currently, the server is linked with Stanford University, Golden Gate College, Cal Arts, and other institutions.

The server consists of a UNIX workstation and a special sound-mixing console. The workstation, specially designed to enable the console to mix various sounds from various places, manages participants' behavior in the virtual space. Sounds are mixed according to parameters generated by participants' positions in virtual space.

Contact
MASAKI FUJIHATA
Faculty of Environmental Information

Keio University
5322 Endo, Fujisawa
Kanagawa, 252 JAPAN
masaki@sfc.keio.ac.jp

In collaboration with

YOUICHI KATO
NTT Human Interface Laboratories

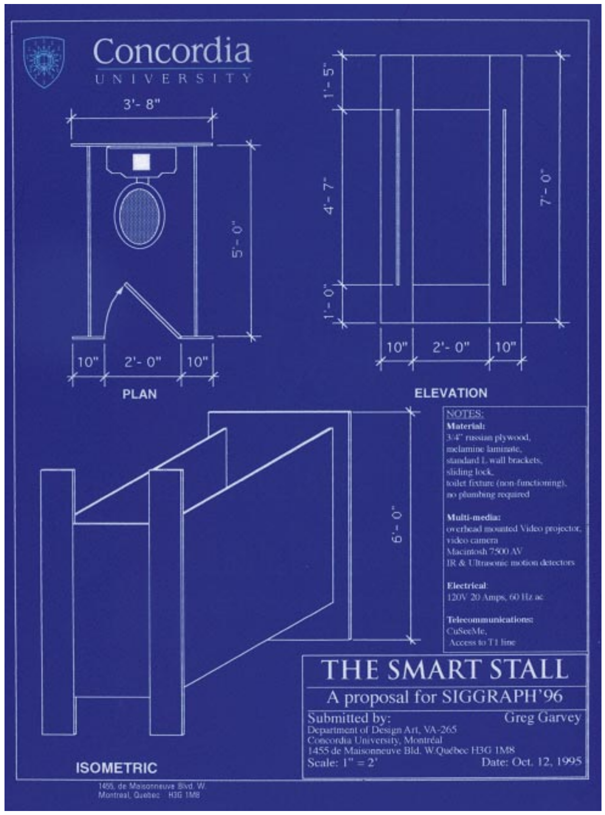
GEN SUZUKI
NTT Software Corporation

TAKASHI KANEKO
NTT Project InterCommunication Center

The *Smart Stall* challenges the aims of ubiquitous computing with the question: Will computers be with us no matter where we are? If consumers have told the talking car to shut up, who will tolerate the user-friendly bathroom fixture cheerfully making suggestions or worse interrogating the user? What could be more inappropriate than a bathroom stall doing double duty as a telecommunications interface where the user can look down into the bowl, see another user (looking as well), and hold a conversation across a local area network? Is no aspect of the human condition safe from the gratuitous intrusion of technological improvements?

Operation

Motion sensors detect potential users passing by, and a bureaucratic voice announces: "STAND IN LINE! SINGLE FILE AND NO TALKING!" Once a user walks into the stall and closes the latch, the deafening roar of a stadium-sized crowd fills the environment. A shrill voice commands the user to lift the seat and barks additional instructions. The docile user looks down into the toilet bowl and sees another user through CU-SeeMe technology. The user can talk, or, if graffiti-minded, write on the white board section of the enclosure to post messages. When there is no other user, the head of a famous politician appears grafted onto a body of a fly and is video-projected onto the water in the toilet bowl squealing "HELP ME! HELP ME!" (In homage to the movie "The Fly"). When the user exits the stall, a status check is performed and a female voice admonishes the user to "PUT DOWN THE TOILET SEAT!"



Contact
GREGORY P. GARVEY

Concordia University
Department of Design Art, VA-265
1455 de Maisonneuve Boulevard West
Montréal, Québec H3G 1M8 CANADA
GGarvey@vax2.concordia.ca

The title of this interactive installation, *Teleporting an Unknown State*, is borrowed from the first scientific paper ever published on the subject of teleportation. The installation takes the idea of teleportation of particles (and not of matter) out of its scientific context and transposes it to the domain of social interaction enabled by the Internet. Following my previous work with telematic interactive installation and my exploration of non-semiological forms of communication with electronic media, this new installation uses remote transmission of video images not for their representational content but for their optical phenomenon as wavefronts of light. Internet videoconferencing is used to teleport light particles from several countries with the sole purpose of enabling real biological life and growth at the installation site. A new sense of community and collective responsibility emerges from this context without the exchange of a single verbal message.

This piece connects a physical gallery to the placeless space of the Internet. In the gallery, the viewer sees an installation: a monitor hangs from the ceiling and faces a pedestal, where a single seed lays on a bed of earth. At remote sites around the world, anonymous individuals point their digital cameras to the sky and transmit sunlight to the gallery. The photons captured by cameras at the remote sites are re-emitted through the monitor in the gallery. The video images transmitted from the international sites are stripped of any representational value and used as conveyors of actual wavefronts of light. The slow process of growth of the plant is transmitted live to the world over the Internet as long as the exhibition is running. All participants are able to see the process of growth.

Through the collaborative action of individuals around the world, photons from distant countries and cities are teleported into the gallery and are used to give birth to a small and fragile plant. It is the participants' shared responsibility that ensures the plant's growth as long as the show is open.

This piece operates on a dramatic reversal of the regulated unidirectional model imposed by broadcasting standards and the communications industry. Rather than transmitting a specific message from one point to many passive receivers, *Teleporting an Unknown State* creates a new situation in which several individuals around the world transmit light to a single point in the New Orleans Contemporary Arts Center. The ethics of Internet ecology and social network survival are made evident in a dispersed and collaborative effort.

Contact
EDUARDO KAC

University of Kentucky
207 Fine Arts Building
Lexington, Kentucky 40506 USA
+1.606.257.6055
ekac1@pop.uky.edu

This essay discusses interactive art events realized on the Internet in conjunction with other electronic media, such as television, radio, telephones, and telerobotics. The essay includes references to material that can be immediately accessed on the Internet. The reader is invited to read by the glow of the CRT, letting digital strokes carry him or her from one country to another.

From the point of view of the artist, one must ask: what is the Internet? Is it a virtual catalogue, or the most perfect gallery for electronic images? For some, it may be an interactive medium, yet others integrate it in hybrid contexts. Its ordinary use might suggest that it is more like the telephone and postal systems, which basically enable exchange of messages between distant interactors. The Internet does incorporate aspects of television and radio, by making it possible to broadcast video, audio, and text messages to small and large groups alike. Perhaps the most exciting feature of the Internet is that it is simultaneously all of the above and more. The Internet can be approached from many angles, and it continues to grow and transform itself as you read your email today. Parallel to the ordinary exchange of messages that takes place daily on this network of networks, some artists are expanding and hybridizing the Internet with other spaces, media, systems, and processes, exploring new zones of experimentation.

Internet hybrid events expose at once the decrepitude of unidirectional and highly centralized forms of information distribution, such as television, and contribute to expanding communicative possibilities that are absolutely unique to this immaterial, telematic form of artistic action. Hybrids also allow artists to go beyond creation of online pieces that conform to the emerging design and conceptual standards of the Internet, therefore evading what very often could seem repetitive solutions to design exercises. Away from the art market, a new international generation of media artists, often working in collaboration, exhibits the same utopian fury and radical innovation that once characterized the modern avant-garde groups. If we will no longer call this new media art avant-garde, we must still acknowledge the critical and innovative scope of its creators' enterprise within and beyond the Internet, despite (or because) of the fact that they don't fit into any of the "-isms" that serve as chapter heads to art history survey books (http://www.uky.edu/FineArts/Art/kac/Telecom. Paper.Siggraph.html).

One such group exploring electronic media hybrids is Ponton European Media Art Lab (http://www.ponton.uni-hannover.de/index.us.html), founded in 1986 and based in Hannover, Germany since 1994. Composed of 15 members but able to mobilize twice as many people depending on the project, this independent group includes artists and technicians from Germany, Italy, France, Austria, Canada, and the US. Their most ambitious project to date was the interactive television event *Piazza Virtuale* (Virtual Square), presented for 100 days as part of the quadrennial international art exhibition Documenta IX, in Kassel, Germany, in 1993. This event was produced by Van Gogh TV, Ponton's television production unit. In 1995, Karel Dudesek, one of Ponton's founding members, left the group and continued Van Gogh TV as a separate project.

The *Piazza Virtuale* project created an unprecedented communication hybrid of live television (based on two satellite feeds) and four lines for each of the following: ISDN, telephone voice, modem, touch-tone phone, videophone, and fax. There was no unidirectional transmission of programs as in ordinary television. With no pre-set rules or moderators, up to 20 viewers called, logged on, or dialed up simultaneously, and started to interact with one another in the public space of television, occasionally controlling remote video cameras on a track in the studio's ceiling. All of the incoming activity from several countries was re-broadcast live from Ponton's Van Gogh TV site in Kassel to all of Europe and occasionally to Japan and North America. A pamphlet distributed in Kassel about the project announced that the *Piazza Virtuale* was "an image-symbolic language of interaction, of taking part – not the distanced naturalistic copy of the world, the aesthetic of the 19th century, which still often is created in electronic worlds of images".

This kind of work is deeply rooted in the idea that art has a social responsibility. The artists act on it directly, in the domains of mediascape and reality. Among other implications, this project took away the monologic voice of television to convert it into another form of public space for interaction, analogous to the Internet. Corporate-hyped ideas of "video-on-demand" or "interactive TV" are, even before implementation, already surpassed by the worldwide interactivity enabled by the Internet. In a statement posted in August 1993, in the newsgroup comp.multimedia, Ponton's interface designer Ole Lütjens stated: "The *Piazza Virtuale* is a step forward for the media art of the future, in which interactive television and international networks can be an important collective form of expression" (http://www.ntt.jp/people/takada/ml/archive/infotalk/199308/19930830.html).

The emphasis here is on the word "collective". Artists explore the mediascape by creating new models of democratic interaction while large corporations promote a hybridization of the Internet with sheer commercial interests, following old models inherited from the highly regulated world of the communications industry. Proposed new technologies, such as the so-called Intercast (http://intercast.org), try to absorb the public space of the Internet and convert it into an extension of the private broadcast world. Intercast technology will enable a new generation of personal computers to receive broadcast Web pages and other data combined with associated cable or broadcast television programming. This technology will deliver data with the TV signal in the vertical blanking interval to personal computers equipped with Intercast receivers and software. The Intercast consortium assumes that viewers will watch TV on a small window on their computer screens and receive additional data on another window on request. The myopic vision behind this assumption ignores the fact that in cyberspace computers are not passive terminals, and that since the very early days of the Internet (http://cuboulder.colorado.edu/Digit/janfeb/InternetHist. html), remote users have been more interested in the possibility of new forms of social interaction than in any other use of the technology. Technological changes are deeply related to political and economical forces. Artists working in electronic media are in a unique position to offer social critiques and offer alternative models from within.

Sharing the same concerns for the political resonance of hierarchical mediascapes and for the socio-aesthetic possibilities of recombined and hybridized electronic media expressed by Ponton and Van Gogh TV, since 1989 I have been working with Ed Bennett in the *Ornitorrinco* project of telepresence installations (http://www.uky.edu/Artsource/kac/kac.html). In Portuguese, "ornitorrinco" means platypus, an animal popularly thought of as a "hybrid" of bird and mammal. The concept of telepresence in art, which I introduced in my 1990 article "Ornitorrinco: Exploring telepresence and remote sensing" (http://www.uky.edu/FineArts/Art/kac/ornitorrinco.abstract.html), has been widely used in the scientific community since the early 1980s. It references emerging remote control scenarios, in which a person guides a telerobot from afar and receives visual feedback, thus gaining a sense of presence in the remote environment.

The basic structure of the *Ornitorrinco* series of telepresence installations is comprised of the wireless telerobot itself, regular phone lines (both for vision and remote control), and remote spaces. Viewers become participants as they transport themselves to the remote body and navigate the remote space freely by pressing the keys on a familiar telephone. Ornitorrinco remote spaces are always built to the scale of the telerobot, inviting viewers to abandon the human scale temporarily and to look at a new world from a perspective other than their own. In our telepresence event, *Ornitorrinco in Eden*, realized on October 23, 1994, we hybridized the Internet with telerobotics, physical (architectural) spaces, the telephone system, the parallel cellular system, and a revised if literal digital "televison". This enabled participants to decide by themselves where they went and what they saw in a physical remote space via the Internet. Anonymous participants shared the body of the telerobot, controlling it and looking through its eye simultaneously. This telepresence installation integrated new non-formal elements, such as co-existence in virtual and real spaces, synchronicity of actions, real-time remote control, operation of telerobots, and collaboration through networks.

Ornitorrinco in Eden bridged the placeless space of the Internet with physical spaces in Seattle, Chicago, and Lexington, Kentucky. The piece consisted of these three nodes of active participation and multiple nodes of observation worldwide. Anonymous viewers from several American cities and many countries (including Finland, Canada, Germany, and Ireland) came online and were able to experience the remote installation in Chicago from the point of view of Ornitorrinco, a mobile and wireless telerobot in Chicago controlled in real time by participants in Lexington and Seattle. The remote participants shared the body of Ornitorrinco simultaneously. Via the Internet, they saw the remote installation through Ornitorrinco's eye. Participants controlled the telerobot simultaneously via a regular telephone link (three-way conference call) in real-time.

In the new interactive and participatory context generated by this networked telepresence installation realized over the Internet, communicative encounters took place not through verbal or oral exchange but through the rhythms that resulted from the participants' engagement in a shared, mediated experience. Viewers and participants were invited to experience together, in the same body, an invented remote space from a perspective other than their own, temporarily lifting the ground of identity, geographic location, physical presence, and cultural bias. As the piece was experienced through the Internet, anybody in the world with Internet access could see it, dissolving gallery walls and making the work accessible to larger audiences.

By merging telerobotics, remote participation, geographically dispersed spaces, the traditional telephone system as well as cellular telephony, real-time motion control, and videoconferencing through the Internet, this networked telepresence installation produced a new form of interactive experience which, in consonance with Ponton's work, points to future forms of art. If mass media's unidirectional discourse is to renew its structure and its reach through pseudo-interactive gadgets in the next century, it is clear that more and more people will live, interact, and work between the worlds inside and outside the computer. As a result of the expansion of communication and telepresence technologies, new forms of interface among humans, plants, animals, and robots will be developed. This work is taking a critical step in this direction.

With new wearable computers, portable satellite dishes, wristphones, holographic video, and a whole plethora of new technological inventions, telecommunications media will continue to proliferate, but by no means can this be seen as assurance of a qualitative leap in interpersonal communications. Networked and interactive art works create a context in which anonymous participants perceive that it was only through their shared experience and non-hierarchical collaboration that little by little a new experience is constructed. In this new reality, spatio-temporal distances become irrelevant, virtual and real spaces become equivalent, and linguistic barriers can be temporarily removed in favor of a common experience.

New York-based Canadian video artist, composer, and performer Phillip Djwap produced the satellite/MBone (Multicast Backbone or Multimedia Backbone) telecast "El Naftazteca: Cyber TV for 2000 AD", in collaboration with Mexican artist Guillermo Gómez-Peña and Adriene Jenik, on November 22, 1994 (http://hibp.ecse.rpi.edu/~stewart/iear/el_naftazteca.html).

The character El Naftazteca is "a renegade high-tech Aztec who commandeers a commercial television signal and broadcasts a demonstration of his Chicano Virtual Reality machine from the techno-alter setting of his underground bunker. The Chicano Virtual Reality machine enables El Naftazteca to instantly retrieve any moment from his or his people's history and then display the moment in video images," explains Gómez-Peña, a participant in the international mail art movement in the 1970s who addresses issues of multiculturalism in his work with several media, including film, video, radio, and installation art. "What will television, and performance art, look like in 10 years? It will have to be multilingual and it will marginalize everyone," states Gómez-Peña. An interactive component to the production encouraged viewers to phone the iEAR Studios of Rensselaer Polytechnic Institute and examine the basic cultural assumptions they maintain about U.S.-Latino relations. Via the MBone, computer users communicated directly with El Naftazteca for the 90 minutes of the performance.

This was one of the first art works to explore the MBone (http://www.eit.com/techinfo/mbone/mbone.html). A virtual network, layered on top of the physical Internet to support routing of IP multicast packets, the MBone is applied in network services such as audio and video conferencing around the world. Today it is mainly used by scientists to interactively attend videoconferences, although some cultural manifestations already can be seen in several countries.

Exploring the hybridization of radio and the Internet, Austrian artist Gerfried Stocker (http://gewi.kfunigraz.ac.at/x-space/bio/stocker2.html) created *Horizontal Radio* in collaboration with many other artists and technicians in several countries (http://www.ping.at/thing/orfkunstradio/HORRAD/horradisea.html). The project ran for 24 hours live (June 22 to June 23, 1995) during the Ars Electronica Festival in Linz, Austria, on the frequencies of many radio stations in Australia, Canada, Europe, Scandinavia, Russia and Israel, on the Internet, and at network intersections in Athens, Belgrade, Berlin, Bologna, Bolzano, Budapest, Edmonton, Helsinki, Hobart, Innsbruck, Jerusalem, Linz, London, Madrid, Montreal, Moscow, Munich, Naples, Quebec, Rome, San Marino, Sarajevo, Sydney, Stockholm, and Vancouver.

The project was loosely based on the theme of "migration" and intentionally challenged the standardized forms of communications promoted by big broadcasting institutions and entertainment corporations. *Horizontal Radio* created a new form of mediascape experience, in which self-regulated groups around the world collaborated on a single piece, integrating diverse communication features such as real-time transmissions typical of broadcast radio and the asynchronous nature of Internet audio. Participants merged several old and new technologies to transform radio into a space for the exchange of audio messages. This new audio environment, which combined multiple forms of sound art such as tape compositions, live-concerts, telematic simultaneous events between some of the participating stations, sound sculptures, texts, and sound collages triggered by the Internet, emphasized dialogic distribution and created a sense of equidistance that transcended the limited spatial range of radio transmitters.

Another important hybrid piece, this time merging television, radio, telephones, and the Internet, was *From Casablanca to Locarno: Love reviewed by the Internet and other electronic media* (http://www.tinet.ch/videoart/multimedia.html), realized by French artist Fred Forest (http://www.tinet.ch/videoart/fredforest.html) on September 2, 1995, in Locarno, Switzerland. In this piece, the artist transmitted the film "Casablanca", with Humphrey Bogart and Ingrid Bergman, without sound and with text onscreen informing the public about the possibility of interactive participation. The audience used the Internet and called participating radio stations to fill in with creative and improvised dialogues. Forest also controlled the images viewed on the screen from a theater in Locarno, open to the local public and transformed into a radio and television studio specially for this piece.

Undoubtedly, the Internet represents a new challenge for art. It foregrounds the immaterial and underscores cultural propositions, placing the aesthetic debate at the core of social transformations. Unique to postmodernity, it also offers a practical model of decentralized knowledge and power structures, challenging contemporary paradigms of behavior and discourse. The wonderful cultural elements it enables will continue to change our lives beyond the unidirectional structure that currently give shape to the mediascape. As participants in a new phase of social change, facing international conflicts and domestic disputes, we must not lose sight of the dual stand of the Internet. If it is dominated by corporate agendas, it could become another form of delivery of canned information parallel to television and radio, forcing netizens (i.e., the world, virtually) to conform to rigid patterns of interaction. Commercial imperatives could continue to prevent the Net from expanding in underdeveloped zones, such as South America and Africa. The Internet also exhibits the risk of making all cultural artifacts look the same, with virtual surfaces, standard interfaces, and regulated forms of communication.

The Internet has come a long way from the original small-scale network based on a command-line interface. It is clear that the future of art and the future of the Internet will be intertwined. What the Internet itself will become, and what new art forms will emerge, are issues that must be addressed in the present. We must ask, however: how can the Internet be a truly global space when only 20 percent of the world's population has a telephone and countries such as Haiti have levels of illiteracy reaching 85 percent? The Internet itself is not the cause of these problems, neither is it the solution to fundamental problems such as the uneven distribution of wealth. The Internet mirrors social relations established outside of cyberspace. We must keep this in perspective as new technologies perpetuate existing social imbalances and new art forms point to alternative public scenarios.

Contact
EDUARDO KAC

University of Kentucky
207 Fine Arts Building
Lexington, Kentucky 40506 USA
+1.606.257.6055
ekac1@pop.uky.edu

An altar is a meeting place, a point of contact and intersection between human beings and the divine. Damballah, Legba, Guede, and Erzulie are some of the major loa (spirits, mysteries) in the African-Haitian religion Vodun, popularly known as Voodoo or Hoodoo in New Orleans. Damballah's symbols are the rainbow and the bridge; thus both the SIGGRAPH 96 location in New Orleans and the Art Show theme provide a focus for a Vodun altar installation. The main altar includes a central group of backlighted iris prints, with silk side panels. The space is defined by draped fabric forming a small proscenium stage. A secondary altar exists as a Web site with links to other sites containing related background information and imagery.

A Vodun altar is created primarily by one designer but the final product is a collaborative effort. Once in place, the altar is never static. The work is thus both participatory and additive. SIGGRAPH 96 attendees can add elements to the altar in two ways: by photographing objects with a digital camera and adding them to the Web site, and/or by physically adding an object to the main altar. In either case, participants add personal commentary, and the altar grows from a personal devotion to a public offering.

Scholars in the field are invited to contribute commentary or images to the Web site. Votive objects purchased ahead of time from local vendors will be available for the viewer to add, or viewers may choose to view the altar and then return with an object. Digitized contributions will be added to the Web site with commentary from each donor. To invite broader participation beyond SIGGRAPH 96 attendees, contacts with community cultural outreach centers will be made in advance, and the Web site will identify related Vodun sites in New Orleans (e.g., Marie Laveau's tomb) for visitors to the city.

The loa occupy an intermediary position between human life and a supreme being. Translated, the word loa, or lawo, means mystery or spirit. Practitioners are initiated under the protection and guidance of one or more loa with whom they have some fundamental affinity. An altar is constructed for use in the context of an initiation ceremony and for subsequent observances of the faith. Although Vodun and other African-derived religions in the orisa-loa tradition constitute a world faith, they are often misunderstood and misrepresented as exotic cults with voodoo dolls and zombies. As intermediaries, each loa is a bridge between divine agency and human life. Legba is the guardian of the gates, pathways, and communicative exchange. Guede is the loa of the cemeteries and occupies an intermediary position between life and death. Erzulie combines many of the qualities of the archetypal female that are separated in other Western traditions. She is Virgin, Prostitute and Mother. As Erzulie Ge-Rouge, she is the fury of the woman scorned; as Erzulie Freda, she is the virgin of miracles. Damballah is the loa associated with cosmic order and with the cycles of birth, life, death, and regeneration.

Although Vodun, Santeria, and Candomble are distinct diasporic religions, still evolving in Haiti, Cuba, and Brazil, respectively, they share some common African antecedents. I have drawn on common qualities in several altar traditions while attempting not to dilute or demean any of the specific and unique qualities of each.

Some of the imagery, color coding, and symbolism incorporated in this installation will be readily recognizable by Santerian and/or Vodun practitioners. Santerian altars or tronos utilize shapes suggested in the way fabric is draped to honor specific orisa. Fabric bunched in ripples on a ceiling evokes Osun's waves. Sequined borders might refer to the froth of sea foam for Yemaya. Peaks of white fabric refer to Obatala's more aloof position on a mountaintop (Brown, 1993). Haitian altars incorporate chromolithographs of Catholic saints. A lithograph of St. Patrick is understood to represent Damballah. African orisa/loa traditions survived to a greater extent in Catholic settings, where it was possible to identify the loa with Catholic saints in order to avoid religious persecution.

Vodun is nonexclusive (Thompson, 1993). Affinities with the symbols and imagery of other religious faiths (most notably Catholicism) are readily absorbed and reinterpreted. My altar borrows imagery from Buddhism, Catholicism, Vodun, and Santeria. After reading a brief overview of the content and symbols, viewers are invited to add elements representative of their own faiths that are aesthetically and thematically consistent with the installation as a whole.

For the non-practitioner, the Web site decodes some of the Vodun imagery. Links to other sources of information on the Web will further instruct the non-initiate. African religions in the Americas have a considerable following, yet they are still marginalized. The artists who construct these altars as private devotions or for public ceremony are similarly relegated to the periphery. The altar and the accompanying Web site serve to instruct the public about the philosophy and origins of Vodun while making a link with a vital part of New Orleans culture.

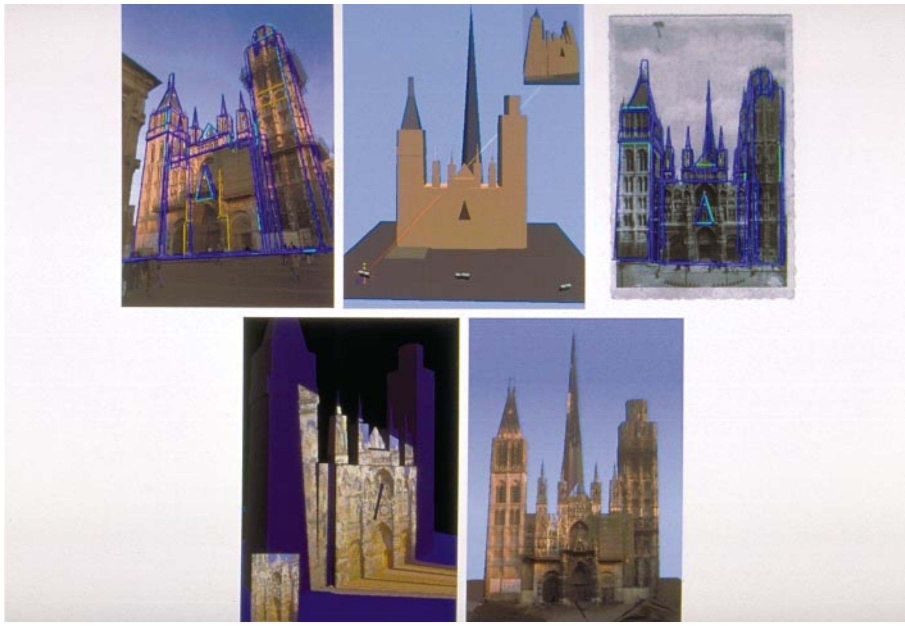
References

David Brown, Thrones of the Orichas: Afro-Cuban Altars in New Jersey, New York and Havana, African Arts.Volume XXVI, No. 4 October, 1993.

Robert Farris Thompson, Face of the Gods: Art and Altars of Africa and the African Americans, New York: The Museum for African Art, 1993, p. 20.

Contact
ANNA MARIA CHUPA

Department of Art and Art Education
Delaware State University
Dover, Delaware 19901 USA



Between 1892 and 1894, the French Impressionist Claude Monet produced nearly 30 oil paintings of the main facade of the Rouen Cathedral in Normandy. Fascinated by the play of light and atmosphere over the Gothic church, Monet systematically painted the cathedral at different times of the day, from slightly different angles, and in varied weather conditions. Each painting, quickly executed, offers a glimpse into a narrow slice of time and mood.

We are interested in widening these slices, extending and connecting the dots occupied by Monet's paintings in the multi-dimensional space of turn-of-the-century Rouen. In *Rouen Revisited*, we present an interactive art installation in which users are invited to explore the facade of the Rouen Cathedral *as Monet might have painted it*, from any angle, time of day, and degree of atmospheric haze. Users can contrast these re-rendered paintings with similar views synthesized from century-old archival photographs, as well as from recent photographs that reveal the scars of a century of weathering and war.

Rouen Revisited is our homage to the hundredth anniversary of Monet's cathedral paintings. Like Monet's series, our installation is a constellation of impressions, a document of moments and precepts played out over space and time. In our homage, we extend the scope of Monet's study where he could not go, bringing forth his object of fascination from a hundred feet in the air and across a hundred years of history.

The Technology

To produce renderings of the cathedral's facade from arbitrary angles, we needed an accurate, three-dimensional model of the cathedral. For this purpose, we made use of new modeling and rendering techniques developed at the University of California at Berkeley that allow three-dimensional models of architectural scenes to be constructed from a small number of ordinary photographs.[1] We traveled to Rouen in January 1996, where, in addition to taking a set of photographs from which we could generate the model, we obtained reproductions of Monet's paintings as well as antique photographs of the cathedral as it would have been seen by Monet.

Once the 3D model was built, the photographs and Monet paintings were registered with and projected onto the 3D model. Re-renderings of each of the projected paintings and photographs were then generated from hundreds of points of view; renderings of the cathedral in different atmospheric conditions and at arbitrary times of day were derived from our own time-lapse photographs of the cathedral and by interpolating between the textures of Monet's original paintings. The model recovery and image renderings were accomplished with custom software on a Silicon Graphics Indigo.[2] The *Rouen Revisited* interface runs in Macromedia Director on a Power Macintosh, and allows unencumbered exploration of more than 20,000 synthesized renderings.

References

1 Paul E. Debevec, Camillo Taylor, and Jitendra Malik. Modeling and rendering architecture from photographs: A hybrid geometry and image-based approach. Technical Report UCB//CSD-96-893, U.C. Berkeley, CS Division, January 1996.

2 http://www.cs.berkeley.edu/-debevec/Research/

GOLAN LEVIN
Interval Research Corporation
1801-c Page Mill Road
Palo Alto, California 94304 USA

PAUL DEBEVEC
University of California, Berkeley
Computer Science Division
545 Soda Hall
Berkeley, California 94720 USA
debevec@cs.berkeley.edu

Pretty Good Privacy is an installation in which a computer and a video camera are installed in an empty room. Outside the room, a monitor displays a virtual reproduction of the room where the visitor is standing, but the room on the monitor's screen is not empty; it is filled with things from the artist's private life: furniture, pictures, shoes, and other intimate miscellany. The artist virtually moves into the exhibition space for the duration of the show.

To experience the installation, the visitor points the camera and looks through the viewfinder. The camera captures the spot in the room that the person is pointing to, but the image in the viewfinder is a computer-generated rendition. The visitor is invited to explore the artist's private life by poking, prying, and snooping around via the camera's viewfinder.

The "video" taken by the camera is transferred to the monitor outside the room, where it can be watched by a larger audience. The artist's private life is being broadcast, echoing so-called "Reality TV".

Contact
CHRISTINE MEIERHOFER

72-74 East 3rd Street #6b
New York, New York 10003 USA
chrissie@thing.or.at

Programmer
MAX KOSSATZ

Sponsors
THE AUSTRIAN CULTURAL INSTITUTE

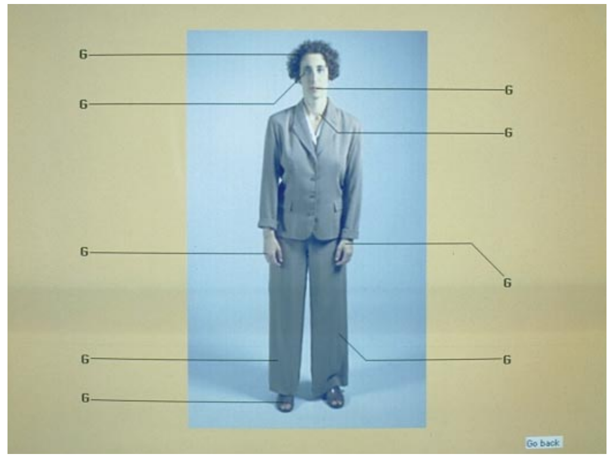
MARKUS BRUEDERLIN
The Federal Austrian Curator for Fine Arts

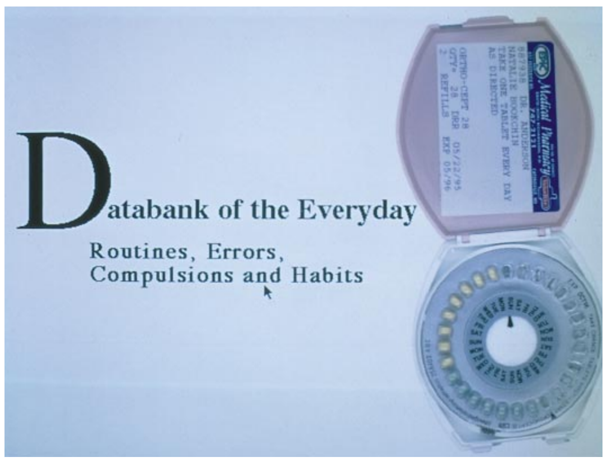
Databank of the Everyday takes as its subject the real everyday uses of computers in our culture: storage, transmission, dissemination, and filtration of bodies of information. The work reflects on what media – from photography to computers – have always attempted to do: represent the truth of life and organize it into well-defined lists and categories.

Photography, for example, begins and ends its history with the idea of the catalog, from William Henry Fox Talbot's inventories to the recent proliferation of electronic image banks. And so, picking up where photography left off, the *Databank* provides a conclusive catalog of an ordinary life. It models itself after commercial data banks with their generic all-encompassing categories such as People at Leisure, Flowers, Nine to Five, and Nature. The *Databank*'s categories are no less all-encompassing and include Wasting Time, Nervous/Bad Habits, Because of My Mother, and Staged for the Camera.

The *Databank* proposes that everyday life consists of a series of loops performed by the body, much like the simple loops performed by a computer program. The ordinary body is like an imperfect machine, flawed in its efficiency by its desires, habits, and compulsions. The *Databank* can be thought of as a catalog of flawed movement studies of the everyday (scratching, shaving a leg, watching TV, and slamming a door), standing in opposition to historical movement studies of Muybridge, Marey, Taylor, and the Gibreths.

The primary graphic interface of the *Databank* is a loop that spins as users move between sections. The selections allow access to the same data in different ways. One section is a subject catalog featuring a diagram of the subject that animates as if in a spasm as her buttons are pressed, triggering access to a loop. Another section is a dictionary of loops with a number of miniature actions that take place simultaneously, choreographed by the user. Yet another organizes the data as antonyms. It presents such actions as pressing up and down on an elevator button,





and taking a shirt off and putting it on.

Featuring the latest in amplified fin-de-siècle rhetoric, the work vehemently perpetuates the current hysteria surrounding new technologies. Again we witness a revolution, and again we hear loud claims about the universality of the change and the transformation of everyday life. (History, as we know, also repeats itself like a loop.) And so in keeping with the tradition, the *Databank* heralds its very own 21st-century manifesto, in compliance with early-20th-century avant-garde movements.

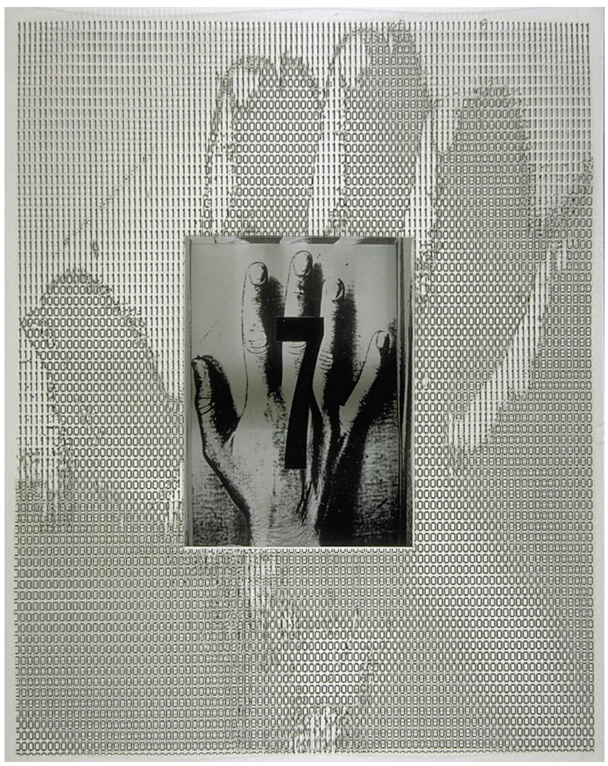
As digital media replaces film and photography, it is only logical that the computer program's loop should replace photography's frozen moment and cinema's linear narrative. *Databank of the Everyday* champions the loop as a new form of digital storytelling; there is no true beginning or end, only a series of loops with their endless repetitions, halted only by a user's selection or a power shortage.

Contact
NATALIE BOOKCHIN

Onativia Crossing
Lafayette, New York 13084 USA
nbookchi@mailbox.syr.edu

Pablo Picasso once said: "Those who can't paint, photograph." Perhaps that explains the need for retaliation by photographers toward "new" media. In other words, if you can't photograph, digitize.

What Kind of Pictures Do You Take? emerged from the frustration I feel about the relationship between the photograph and the digital image. There is a stigma attached to photographers working with computers, a Picasso-esque hostility towards new technology. At the same time, there is a survivalist backlash coming from the computer world, a smug kind of reprisal that all photographers who work digitally only do so in fear of their livelihood. There are, however, a few of us multimedia types who work in a variety of materials interchangeably. We slip easily from one medium to the next choosing the appropriate media for the message.

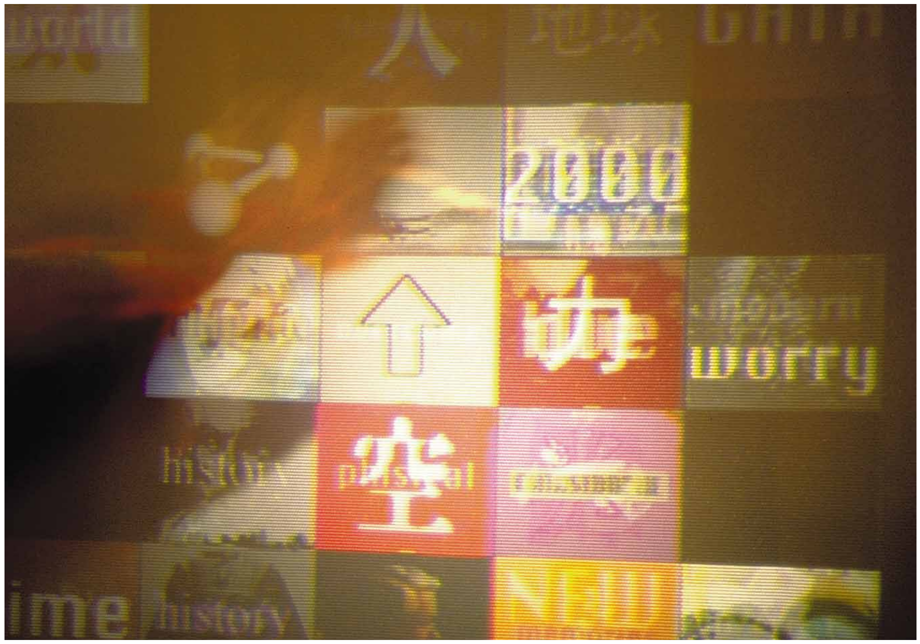


What Kind of Pictures Do You Take? is a statement about being labeled – boxed in, if you will – into separate categories within art and photography. In photography, there is a separation of themes: portraiture, advertising, photojournalism, documentary, abstraction, and traditional forms, along with the ever-present threat: digital imagery.

My question to all of us is what of box number 10, a box that appears empty because its image cannot be compartmentalized? For me, as an artist, the computer is another tool. It has become a bridge between my mind and my materials. Like my camera and my hands, my keyboard has become an extension with which to convey my thoughts. *What Kind of Pictures Do You Take?* is a literal, smack-in-the-face comment on how media are translated and accepted. It is a piece that directly confronts the visitor and asks: what kind of pictures do you take?

Contact
LIZ LEE

17 East Jones Lane
Savannah, Georgia 31401 USA
EAlee@scad.edu



Wall is a work that generates various sounds and images in real time based on the movement of a visitor's hands in space. An invisible cubic grid with 100 invisible cells extends out in front of the visitors as far as they can reach. The grid has four layers. Each layer consists of five horizontal rows and five vertical columns. Visitors can freely manipulate the work by touching this invisible grid (entirely without tactile sensation). Different sounds and images are allocated to the four layers of the grid. The images are generated on a screen. Audio sounds are emitted from speakers placed near the screen. When a hand probes into the invisible grid, a sound and an image are activated each time it passes through a cell. First, the hand touches a layer that generates sound effects and moving pictures. Next, the hand reaches a layer that brings forth words. The hand's movement is captured with two video cameras set in front of and next to the grid. The signals are converted into images and sounds through the computer and digital sound sampler.

I try to avoid difficult operations, as well as mechanical interfaces such as joy-sticks or touch panels. I want participants to be able to interact freely in a three-dimensional space. It is important to me that my interactive work incorporates an environment in which users can easily participate with little information. Participants can continuously concentrate on an act if the interface they use is uninterrupted by intervals, and since the interface area and the viewing position are the same (the outstretched arm points directly to the screen), participants can concentrate entirely on the screen. Of course, since the interface is invisible, it is difficult to conjure sounds and images as accurately as one would like. I hope that participants will enjoy the coincidental combination of sounds and images.

It is critical that the work instantly generates sounds and images that reflect the behavior and reactions of the human participant. I aim for this sense of oneness between human behavior and the response to sounds and images. In the East, space is not empty. It is filled with feeling or energy called Ch'i. Some believe that there are various entities within invisible space, such as feelings, thoughts, energies, and intentions. To cite a familiar example, you may have seen how in Chinese Kung-fu movies, the Kung-fu master directs all his energies to throw back his opponent without touching him at all.

In short, human behavior can easily affect the outer world immediately beyond space. *Wall* can provide such an experience virtually. I sought to provide an environment in which a participant's body has a free and direct relationship with the work without touching any equipment. I want the visitor to feel in control of the images and sounds as though there are tiny strings attached to his or her fingertips, to stir within a mysterious sense of oneness between the participant and the surrounding space.

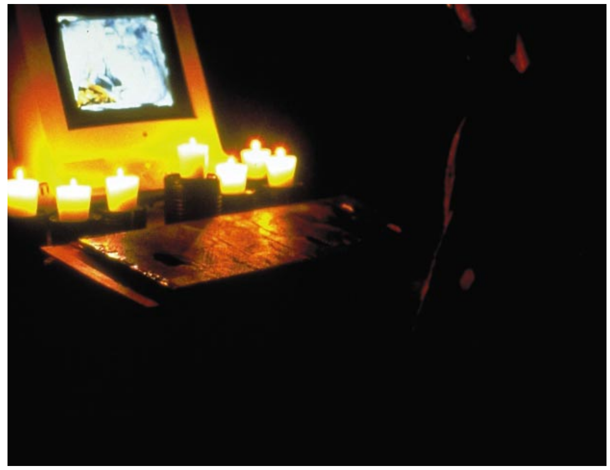
Contact
HARUO ISHII

Trident School of Design
30-1 Ishihata
Narumi-cho Midori-ku
Nagoya-shi, 458 JAPAN
mxc00275@niftyserve.or.jp

Without a Special Object of Worship is an interactive installation exploring imagery inspired by the salt-beaten, Veneto-Byzantine port city of Venice, Italy. Visitors sit at a table in the dimly lit installation space and control computer-based still images and animations by turning the pages of a handmade picture book. Custom electrical wiring allows communication between the book and the computer, with each page of the book corresponding to complementary digital 2D image sequences and 3D animated sequences. The sequences appear on a monitor at the table.

All of the imagery, both in the book and stored in the computer, consists of the artist's original stills and animations. The juxtaposition of the book and the digital imagery serves to bring the book to life by adding motion. The environment is further enhanced by an original sound track inspired by chants and religious liturgy. The integration of image and sound creates a peaceful, sacred space conducive to reflection. While the installation is not specifically religious in nature, the experience could be likened to the personal acts of meditation and prayer. Much as a prayer book, the handmade book acts as a point of departure for these acts. The book structure is the vehicle through which the participant communicates, controlling the pace of the interaction and thus customizing and personalizing the experience.

Books have a place in our cultural history and development that cannot be denied. Currently, we are witnessing the transformation of the book from analog to digital form. While the advantages of the digital book are many, there remain aspects of the physical book form that have not been replicated digitally. Specifically, their organic nature has not been preserved. *Without a Special Object of Worship* preserves the tactile, spatial qualities of the book form while simultaneously taking advantage of technological innovation in digital forms. With this piece, a bridge has been established for continual research and development in the marriage of traditional analog interactive models with their digital counterparts, specifically in the study of book forms.



Contact
JACQUELYN MARTINO

Philips Research Labs
345 Scarborough Road
Briarcliff, New York 10510 USA
jam67@columbia.edu

Sponsor
PHILIPS RESEARCH LABS

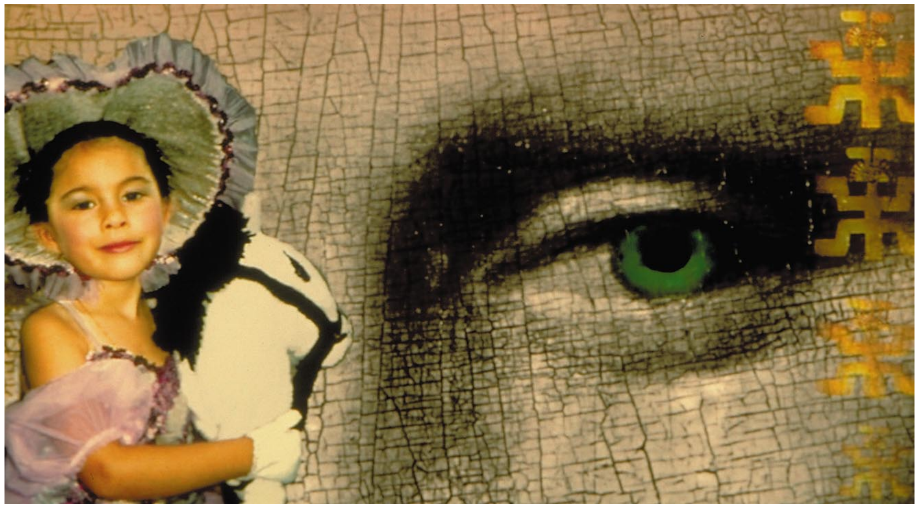
With this project, I am less concerned with the inherent bias of television and the many talk shows it delivers than I am with the personal needs of individuals to use the medium to make human connections with their national and global communities. Willingly presented in an intimate light, often at the expense of appearing weak, offensive, or pathetic, we volunteer to simplify and categorize ourselves in an effort to earn a definable, indexable place within the American social landscape. Television is the mediator of choice. As a mediator, it offers the safety of time and distance between the subject and the rest of the world, facilitating or perhaps demanding the release of personal privacy.

Conversely, living in public, in unmediated real time and space, we maintain distance and preserve privacy. Personal connection with community is absent. There are no clearly defined labels. Identity and location within our world are open to shifts, conjectures, and ambiguity.

What was once private (secrets, vulnerabilities, and anger) are now cataloged and pronounced from the highest mountain, while our public selves have reverted to stealth mode.

Contact
STEVE DAVIS

4047 36th Avenue NW
Olympia, Washington 98502 USA
daviss@elwha.evergreen.edu



What is computer art? Numerical concept or physical reality? Is a print of any kind the "piece"? Does the output media matter? If "art" is the image created, is it not then housed in the storage media? What is more valuable then, the disk or the print?

These are the questions that are addressed through *La Monalisa Chibcha*. The image is a melding of pre-Columbian icons, da Vinci's *Mona Lisa,* and a child. Although this particular combination is based on the nickname my father has given my young daughter, the title represents many things. Mostly, I see the connection of the pre-Columbian icon to a present-day Colombian child: the history and culture that we should pass on to our children. The use of da Vinci's *Mona Lisa* speaks to the incalculable number of regulations of that world-famous portrait. The actual merit of the work has been belittled by overexposure. It has become a cliche. This brings me to the issue explored in *La Monalisa Chibcha*. In a way, the actual image is irrelevant for the asking of the questions.

By creating a digital image, I am using and taking advantage of the many effects and possibilities in image manipulation. My creative decisions are based partly on aesthetic considerations and partly on technical limitations. So far, this does not differ so much from other media. When we are done, "finished", we then face a dilemma. As digital imaging evolves, we need to investigate and resolve what and how we exhibit. The questions start again. Should we paper the world with duplicates of our creations, allowing the finished work to be controlled in its final "look" by technical and financial limitations? Or do we maintain integrity and create for pure enjoyment, curiosity and ART?

We are losing the elusive quality that tints our human memory when we are visually bombarded by the proliferation of available material.

Contact
PATRICIA GALVIS ASSMUS

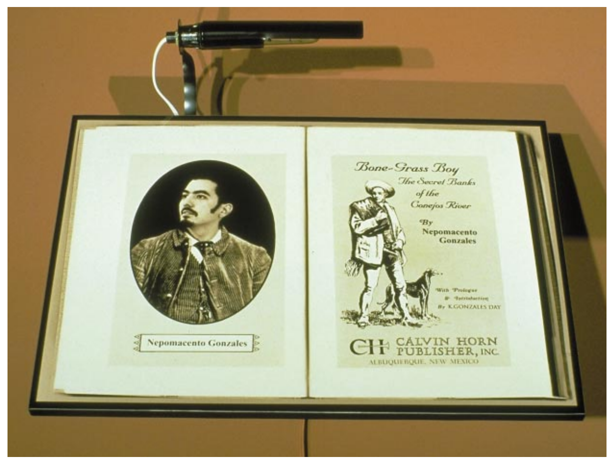
PO Box 954
Amherst, Massachusetts 01004 USA
+1.413.545.1904
tga@art.umass.edu

Much of my childhood was spent with my grandparents in the New Mexico and southern Colorado region, so much of my work has been about the struggles and difficulties encountered by Latino and Native peoples. Generally speaking, I create mixed-media installations mimicking the ethnographic museums. Unlike a traditional museum of natural history, my installations attempt to offer positive and complex representations of my culture and beliefs.

Bone-Grass Boy: The Secret Banks of the Conejos River is a literary trope of the frontier novel of the late 19th century. These novels often depicted Native and Latino inhabitants as ridiculous personages encountered on an otherwise naturalized conquest of the West. *Bone-Grass Boy* is their nemesis.

Begun as a series of stories told to me by my grandfather, *Bone-Grass Boy* has evolved from family genealogy, regional histories, and some historical material related to the Native American berdache tradition. The berdache (or transgendered spirit) dates back to pre-conquest America (North and South) and remains a problematized position within the Latino/Chicano culture.

The Bone-Grass story is set during the Mexican/ American war (1846-48), a period that saw bitter struggles between cultures. American industrialism caused the economic collapse of the pre-industrial Southwest. Berdachism, greatly diminished under Spanish Christianity, fared even poorer under U. S. assimilationism. As a project, *Bone-Grass Boy* parallels the effects of industrialism with the effects of digital technology today, raising questions about cultural preservation and reinvention, while strategizing a position within technologies of the future.



My work frequently makes use of elaborate tableaux comprised of painted backdrops, props, and realistic cast figures, and are presented along with digital photographs depicting the characters. The digital photographs, printed as c-prints, also incorporate painted backdrops, props, and historical images.

As for the characters, there is Ramoncita, the Native/Latina berdache (based on a true story) who is forced to kill the rancher to whom she has been sold, and Nepomacento, the New Mexican soldier who fights for Mexico, only to have to sneak back to his homeland, now America.

I play all of the characters in each image, disguised, digitally modified, cast, carved, or painted. The strategy draws in part on Donna Haraway's essay, "A Cyborg Manifesto," in which she heralds the coming of a true hybrid of organism and machine. For Haraway, the cyborg represents a kind of idealized postgender positionality, but *Bone-Grass Boy*, with its inherent racial and cultural hybridization, adds a level of complexity to Haraway's model. This, combined with the trappings of an ethnographic museum, allows us to consider Homi K. Bhabhas' three-part strategy for the empowerment of the colonial subject, which demands a recoding of aboriginal or native cultures and begins to suggest something beyond Haraway's utopic cyborg vision.

It should be noted that while the work references a specific history, my goal is not simply to find these forgotten histories and present them. It is to make their absence the subject, so that we can begin to look at some of the real issues in the debates surrounding the notion of cultural and racial representation. Like any good storyteller, *Bone-Grass Boy* raises difficult questions, and if we consider Judith Butler's notion of a "pure dialectic," then the tale begins to suggest the recuperative potential of technology, not simply by disrupting the status quo (the dark side of Modernism) but by strategically challenging how (and by whom) technology will be used in the future.

Contact:
KEN GONZALES DAY

7712 Lexington Avenue
West Hollywood, California 90046
USA
kday@scrippscol.edu

*"**W**hy there is any aesthetic difference between a deceptive forgery and an original work challenges a basic premise on which the very functions of collector, museum, and art historian depend."*

Nelson Goodman,
Art and Authenticity,
Languages of Art, 1976

As Goodman notes, authenticity is central to the experience of art and intimately linked to monetary value. One example is the ongoing controversy over attribution of Rembrandt's paintings. In turn, our denotations for monetary value, banknotes, are linked to the issue of authenticity through the history of the counterfeit.

New technologies of reproduction introduce new questions about authenticity. For example, photography's mechanical reproduction of images illuminated the subtle distinction between the reproduced image of the painting and the authentic, "original" painting that is unique in time and space (cf.Walter Benjamin, 1936). And the technology of xerography allows even the unskilled to participate in the counterfeiting of money.

As the technologies of reproduction evolve into the digital realm, the distinction between authentic and replica effectively vanishes (cf. William Mitchell, 1992). Yet human viewers and museum curators still crave evidence of authenticity in the corporeal experience of original artifacts. The newest technology of reproduction, the Internet, combines digital representation with almost instantaneous remote access and raises new questions about authenticity.

Consider the dozens of Internet-accessible remote cameras that, upon request, generate a live image of a freeway, fishtank, or toilet stall. These "installations" go beyond prestored digital images because the viewer, by clicking on the WWW interface, commands the taking of a live snapshot co-located with something that is unique in time and space. Although this addresses the issue of authenticity, since the original object is required for each snapshot, it creates a new question: is the installation authentic (live) or is it merely a prestored frame from a videotape? Indeed, several purportedly "live" cameras on the Internet have been exposed as forgeries.

WWW installations that allow the user to aim a tele-robotic camera and thereby direct the gaze are harder to counterfeit but not impossible: the effect can be achieved by indexing into an array of prestored images. Tele-robotic WWW installations that go one step further and allow users to view and manipulate a remote environment provoke users to apply basic corporeal instincts about physics and materials to validate the authenticity of the remote apparatus. Still, users can be fooled: the Rome Air Force Base offers a forgery that continues to masquerade as a tele-robotic site.

Thus the process of deciding authenticity of a tele-robotic WWW site engages the corporeal instincts of the human viewer. We choose to focus on the issue of authenticity at several levels by presenting the WWW installation titled: *Legal Tender*.

Legal Tender incorporates tele-robotic technology to allow viewers to remotely inspect two banknotes, labeled A and B (cf. the Turing Test). One is a genuine US $20 bill. The other is artificial: a counterfeit. Users can position the camera remotely to examine each bank note in detail and can perform active experiments. Afterward, observations can be posted to a public online log.

In addition to the question of which note is genuine, the installation raises doubts as to

whether or not the remote images are in fact live or pre-stored. Is the installation itself authentic? And if it is, since the physical presence of a counterfeit banknote is illegal, the installation may not be legal. Indeed, the authenticity of the installation hinges on the inauthenticity of its contents.

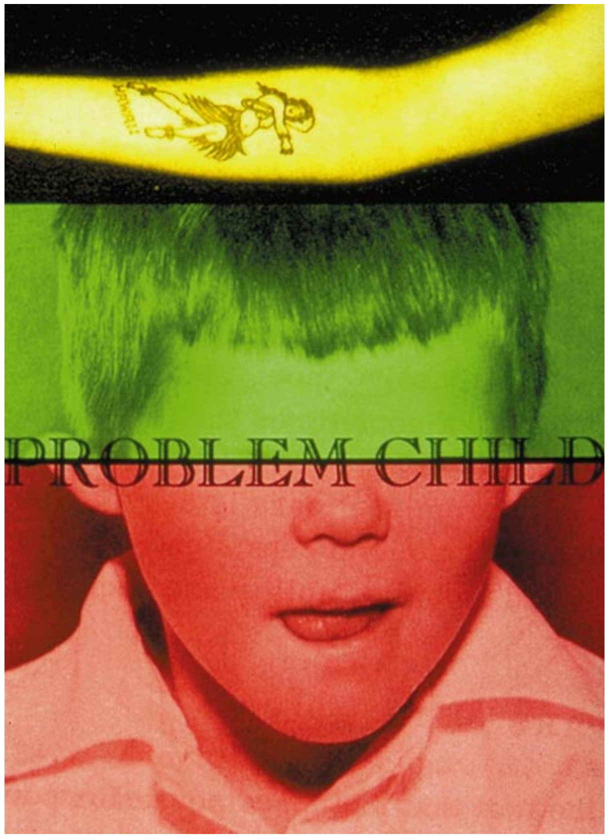
References

J.S.G. Boggs
Turing Test
Nelson Goodman's Text
Rembrandt/Not Rembrandt at the Met
The Rembrandt Project
U.S Air Force Rome Lab
"Snowball" Camera
Paper Money Collections online
History of Money
Other Related Sites

Contact
KEN GOLDBERG

University of California, Berkeley
4189 Etcheverry Hall
Berkeley, California 94720 USA
goldberg@ieor.berkeley.edu
http://www.counterfeit.org

I continue to work on this series of images that are themselves parts of other contained series. The total of the images is large – more than 200 in all. Their recursive nature and their excessive number are part of the installation component in which I have worked for several years.



The images range in size from relatively small (8.5 x 11 inches) to sizable (48 x 60 inches). They are created from various found images (flat and three-dimensional), my own snapshots and videos, as well and complete computer constructions. Many of the images contain elements from other series in rather distorted relationships in time and place. The ways in which a pseudo-narrative is set up and then destroyed are numerous.

One large portion of the images is installed in the Ernest N. Morial Convention Center and another similar portion is installed in the Contemporary Arts Center. Though the context and imagery will be similar in the two venues, there are no duplicate images. My intent is that these images will be stacked, grouped, abutted, and arranged in ways that both aid the viewer in sorting and assimilating meaning and ultimately prevent them from gaining cogent ground due to information overload. Think of this as a fog bank on the information superhighway.

Components of these images are infrequently repetitive, thereby creating links that reflect recontextualization, such as those created by differing representations of O.J. Simpson, for instance. It is also my intent to play with the cheapening of images in a way similar to what happens in society's burgeoning image glut while investigating what this means to viewers confronted with this in an art context. In the case of The Bridge, it allows me to link two diverse audiences: the SIGGRAPH 96 attendee and the Contemporary Arts Center patron.

I am not interested in electronic interactivity between these groups, nor even in researching the divergence or similarity of their responses. I simply wish to present each group with an experience that on the face of it is the same, but in fact is imagistically unique to each venue.

The images are complete, self-contained, finished artistic creations. The computer simply allows me to appropriate, recontextualize, and create such works rapidly and effectively. I am little interested in the fact that these are "computer-generated" prints. They are instead simply art works – individually, serially, and in composite. This may not meet all the criteria set forth in The Bridge paradigm, but it is what I consider important for myself in using the computer to make art. It is work that arises from the medium's strengths while not weighing itself down with the categorical stipulations of the medium's obvious attributes in high tech.

Contact:
Gerald Cannon

4501 Francesco Road
New Orleans, Louisiana 70129 USA
glcannon@aol.com

M*nemonic Notations* explores the process of memory inherent in all humans. It responds to the presence of a visitor by altering the form and structure of the environment – in effect creating an entirely new image. The visitor's choices are remembered by the machine, and images travel to a new layer as the participant navigates through the program. So while the visitor remains in the *Mnemonic Notations* environment, the interaction between computer and human memory gradually generates new layers.

The interactive structure of *Mnemonic Notations* reflects the relationship between man and the land. The overall structure of the routes through the work is based on the early Buddhist doctrine of creation by causes, which describes the circular or spiralling process of birth, growth, death, decay, regeneration, and rebirth. The images in the interactive work are no longer separate, individual works, but links in an endless circular or spiralling chain. Four of these chains are positioned parallel to each other, and the participant's spiralling route through the work is determined by the choices made in navigating through the 12 layers of graphics and animations that are linked by the interactive chains. Each layer has been deconstructed into at least eight node-groups, which are separate destinations within a layer represented by different interfaces, graphics, and animations. While node-groups may look like a single graphic, they are in fact deconstructed into up to 24 individual nodes, each of which is a clickable interactive "hotspot". Selecting a node triggers an animation, transformation, or relocation to another.

The routes through these maze-like node-groups of graphics and animations are structured so as to mimic and explore the processes of memory. Details of a layer are seen clearly, but the image of a whole layer is so reduced in size as to be unclear. Details of future and past layers are clearly seen, but the totality of the evolution and devolution of the work is an image that is only fully developed in the participant's memory. There are distractions, unasked-for intrusions, flashes of new perception as images invert or blend into their future and past forms, curiosity about what details will be revealed, frustration as animations and graphics that are meaningful to a participant cannot be revisited without risking moving on to another layer, and a gradual understanding and acceptance of the totality of the work.

The work is paced to reflect genesis, growth, decay, memory, and imagination rather than technology. It is designed to calm and illuminate rather than excite.

Contact
PHILLIP GEORGE

11 Miller Street Bondi 2026
Sydney, New South Wales
AUSTRALIA
p.george@unsw.edu.au
rwayment@zeta.org.au

As a member of Generation X, I found myself confronted once again with the question: "Where is Generation X going?" I quickly returned with: "Where did Generation X come from?" I applied this question to myself and found that I did not have a clear understanding of my past.

I did not understand the sacrifices made by my family. I could not see the dreams for their children and their grandchildren to one day stand tall enough to grab the illusive gold ring. How could I expect to balance myself and reach up toward that ring when I had nothing to stand upon?

In order for me to move forward in my life, I found myself searching my past. I had to bridge the gap that time had forged between my ancestors and me. Within a few days, I realized that I can never completely stand on my own, because I will always stand on my family.

After exposing myself to the past, I felt naked and mentally exhausted. I looked at my hands and knew many of the people who went before me. Two words remained with me: dignity and respect. My ancestors held their dignity high. For many that was all that remained. They deserve my respect. I believe that, in the end, we leave this world with little more than our dignity and the respect of our children.

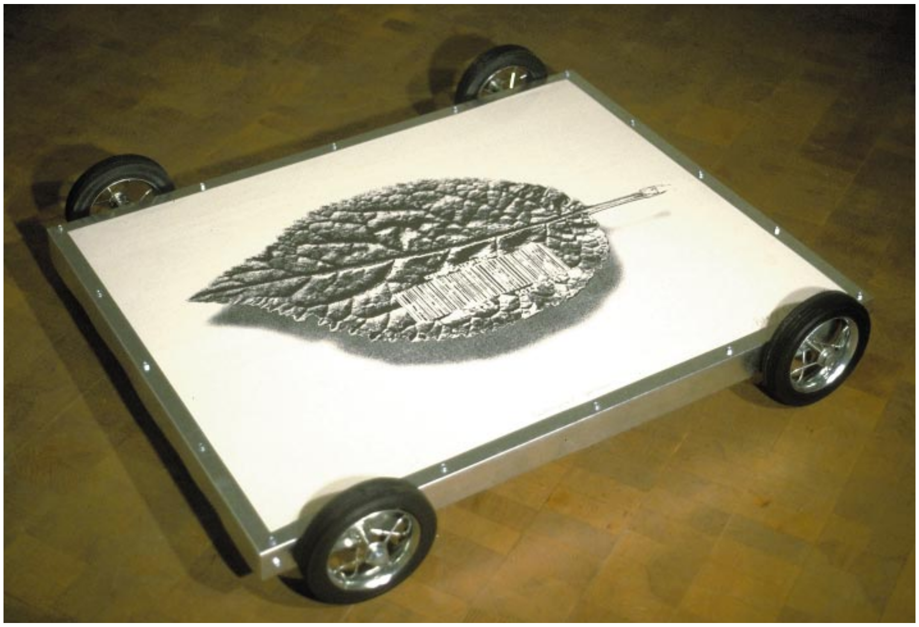
Contact
WILLIAM JEFFERY DIMATTIA

10345 Pecue Lane
Baton Rouge, Louisiana 70810 USA
argusone@ix.netcom.com

Cellular is a lenticular 3D image framed in a light box. It is a visual bridge to the microcosms of cell reproduction and growth. The image, which shows delicate and emergent vibrations of growth in a microscopic world, is a still from an animation based on an algorithm that models the growth of 3D cells. The intuitive self-organization of these cells engenders complex evolving objects.

Contact
YOICHIRO KAWAGUCHI
Institute of Art

University of Tsukuba
1-1-1 Tennodai
Tsukuba Science City
Ibaraki Prefecture 305 JAPAN
yoichiro@geijutsu.tsukuba.ac.jp



Contact
MADGE GLEESON

Western Washington University
Bellingham, Washington 98225 USA
mgleeson@heuson.cc.wwu.edu

Contact
SAM GEBHARDT

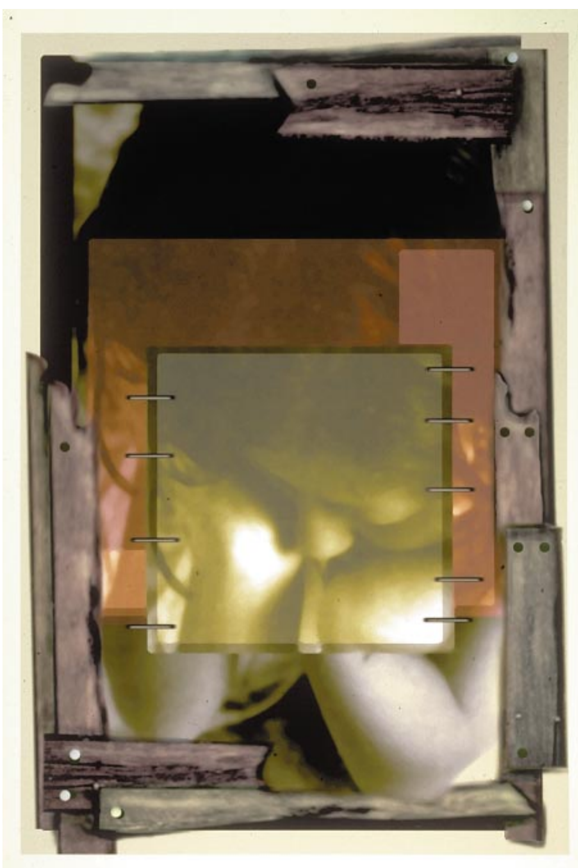
8114 Waters Avenue
Savannah, Georgia 31406 USA
sam@designelite.eng.gulfaero.com

Contributors

(Art)^n Laboratory
STEPHAN MEYERS
ELLEN SANDOR
JANINE FRON

Contact
YUN-KYUNG HUH

School of Visual Arts
207 East 27th Street #LC
New York, New York 10016 USA
Bluemoon95@aol.com



Does computer science in its theory and practice embody discrimination against women, and if so, how does embedded discrimination work itself out in applications to the arts? This essay, guided by this introductory question, will connect concerns of discrimination against women in the field of computer science with issues that arise in the development of theory and application in the emerging electronic computer-based arts. Bias against women in computing, I will suggest, occurs in the epistemology or knowledge construction of computer science inherited from the knowledge construction of modern science, works itself out in knowledge distribution and socialization processes, alienates women, ethnic groups, and class groupings, limits access, and skews applications in the arts.

This bias will be examined through 1) a social study and an historical analysis of the domain of modern science and the field of computer science, and 2) an analysis of data collected through survey questionnaires and follow-up interviews that I developed to further locate bias against women in computing and administered during 1994 and 1995 at two major U.S. research institutions with strong concentrations in computer science and arts related areas. These several methods of inquiry combine to search out how the formations of modern science and computer science interact with the arts and gender. The findings will be employed in initial theory building for the emerging electronic arts.

Although this essay will focus on women, including women of minority groups, computing, and the arts (omitting findings concerning minority peoples), an alienation of women also includes men, eliciting an ethical concern of social justice that affects the entire computer science community and communities incorporating computer technologies.

Difficulties for women in computing have been communicated through a variety of major research institutions' reports, in numerous computer science publications, and through published critical studies. To note only a few: the Massachusetts Institute of Technology Electrical Engineering and Computer Science Departmental Reports on Women and Computing in 1983 and 1995, and *Communications of the ACM* issues on "Women and Computing" in 1990 and 1995.[1, 6, 16, 21] These reports confirm what we have come to recognize: *There are biases against women's participation in computing*.

**The complete essay text is located in the SIGGRAPH 96 Visual Proceedings CD-ROM.*

Epistemology and Computer Science

Social study and historical analyses of the knowledge construction of computer science bring to the fore understandings that illuminate deeper problems and beliefs underlying modern science,[20] its offspring, computer science, and discrimination against women. Let me restate briefly a viewpoint that I develop in earlier publications and that builds on the work of physicist Evelyn Fox Keller.[10, 11, 13, 14] A quote from George Simmel initiated Keller's inquiry into gender and science: "The requirements of… correctness in practical judgments and objectivity in theoretical knowledge… belong as it were in their form and their claims to humanity in general, but in their actual historical configuration they are masculine throughout. Supposing that we describe these things, viewed as absolute ideas, by the single word 'objective,' we then find that in the history of our race the equation objective=masculine is a valid one."[11] Simmel's conclusion leads Keller to question: "How is it that the scientific mind can be *seen* ... as both male and disembodied?"[11]

In her early exploration, Keller asserted that modern science is a domain shaped by males, claiming that science is a socially constructed category perpetuating the deeply held *mythology* that holds objectivity, reason, and mind as male, and subjectivity, feeling, and nature as female.[10] This myth has led to the division of emotional and intellectual labour; women residing in the realms of the personal, the emotional, the particular, "whereas science – the province par excellence of the impersonal, the rational, and the general – has been the preserve of men."[10]

This division affects the very terms in which science has been criticized and has led to two notable omissions in most social sciences of science.[10] First, a failure to take serious notice of the fact that the natural sciences, the "hard sciences," have been developed almost entirely by white, middle-class males.[10] Second: an attempt to identify the nonscientific determinants of the development of scientific knowledge, the social studies of science, has ignored factors related to the human psyche; "science is a deeply personal as well as a social activity."[10] Keller came to the conclusion "that perhaps the most important barrier to success for women in science is derived from the pervasive belief in the intrinsic masculinity of scientific thought."[11] The early years of Keller's investigation brought forth two important understandings: she shifted the emphasis of the question of male and female to that of "beliefs" about male and female, that is gender ideology, and second, she concluded that such beliefs could affect science.[11]

Computer science shares the philosophical base of modern science, situated in traditional western philosophy.[4, 9] The shaping of this epistemological ordering began with the ideas of Plato, who supposed a linear, rational, and abstract approach to knowledge, and with further conceptual development by Descartes, Hobbes, Kant, and Whitehead.[4, 13, 14] This epistemological ordering, combined with historic and social understandings that white males developed modern science and the perpetuated myth that men are involved in intellectual labour and women with the realm of the emotional, brought about a continued populating of the domain of modern science by mainly males. The new field of computer science employs the methodology of the "hard" sciences and its Western epistemological ordering to bring comparable rigor in its own knowledge development.[7] Cartesian epistemology, situated in this tradition, forms the underpinnings of computer science as we know it. Like the domain of modern science and for the same aforementioned reasons, the field of computer science is populated mostly by males.

This ordering of knowledge, from Plato onward, systematically ignores living contexts.[4] Following in this tradition of Western philosophy, computer science also ignores questions concerning gender ideology, ideas about ethnicity and class, considerations affecting power constructs managing electronic-based information and equipment access, and leads to a skewing of computer-based arts applications.[4]

Survey and Interview Formulations

To further investigate beliefs and deeper problems concerning bias against women in computing arising from the epistemological discussion, survey questionnaires and follow-up interviews were developed to search out bias in more applied settings and were administered at two U.S. research institutions in 1994 and 1995. These instruments build upon and expand existing research .[2, 14, 15, 16, 18, 19, 20]

The mainly qualitative survey instrument was distributed in one institution to 154 graduate and 282 undergraduate students in its computer science department and in a related arts research center with a 30% return. The graduate survey was comprised of 1) demographics, 2) five questions searching out obstacles to computing, 3) nine questions investigating salient personal, social, and control beliefs about women in the field of computing,[3] and 4) a question canvassing additional obstacles to computing that the survey failed to address. The undergraduate survey contained an additional quantitative component seeking statistical data.

The single person interview administered to graduate students, academic administrative faculty, faculty members, personnel, and artists, from the computer science departments and computer-based art research centers at both institutions, consisted of three questions that searched out more thoroughly the basic premises of the survey. The interviewing resulted in 21 transcribed interviews.

Survey and Interview Findings

What do the findings offer for a deeper understanding about the knowledge construction of computer science and bias against women? We will focus specifically on findings from the third survey component, searching out salient personal, social, and control beliefs about women in computing.

Personal Beliefs About Women's Participation in Computing in Relation to Knowledge Construction

Looking at personal beliefs about the personal consequences for women in computing, a multiplicity of disadvantages were noted. From the vantage point of knowledge construction, females suffer intellectual intimidation from "the old boys' network", which often stereotypes women as illogical, leaving male instructors with a sense that they are unable to deal with women's apparently differing approaches to knowledge. This furthers a perception that males are given an assumed edge in computing with regard to knowledge comprehension and knowledge development. Some respondents view women as more successful in computing, as they employ a more logical approach; however, this supposition conforms to the existing dominant approach to knowledge acquisition. Other respondents put forward the "critical mass concept," – an understanding that having a larger number of competent women in the field will reduce the amount of knowledge-base intimidation and discrimination.

Interviewee Professor Douglas Kerr of the Ohio State University Computer and Information Science Department noted that a central difficulty for first-year female undergraduate computer science majors is that they do not possess the prior computing knowledge, accompanied by the prior computing experience, of their male counterparts who have been "hacking" on the computer often from the age of four years.[12] This circumstance I label the "time-loss factor," pointing to the gap between what males often acquire at young ages, and what becomes a "time-loss factor" for females who develop computing knowledge and computing experience at later ages. The male working on the computer from the age of four years, becoming sophisticated with the rational and hierarchical development of computing and participating in the male construct already in place, matures in a space that he finds comfortable. This leads to a world of computing that tends to welcome the male, to undermine and distance the female, and by the time the two seek out majors in computer science, the young female believes she can no longer compete. Although her intellectual gifts appear to be equivalent to those of her male counterpart, she does not possess his prior-knowledge, prior-experience base in computing.

Control Beliefs About Women's Participation in Computing in Relation to Knowledge Construction

The category of control beliefs (beliefs about factors that facilitate and obstruct women engaging in computing) points to many similar problems noted under personal beliefs. Additional findings elaborate particular difficulties and exclusions for females from the vantage point of knowledge construction.

A major difficulty is knowledge-base intimidation; women in computing comprehend less, develop less, and often believe themselves to be capable of less. This understanding is advanced through educational systems that facilitate the participation of males in math and science and discourage females. Both male and female respondents at all levels of computer science higher education continually raise the difficulty of sexual harassment in relation to knowledge acquisition and socialization processes.

A second control belief frustrating women's participation is a sense of exclusion. Studies in educational computing research consistently illuminate the predicament of a lack of computing in elementary and secondary schooling, noting attempts to continually improve levels of computing education. And those who generally benefit from the availability of existing computer education are the males. Again, a knowledge-base "time loss factor" occurs in relation to the female. Along with preferred male development in computing in primary and secondary education comes the understanding that computing is becoming more logical, again reiterating the conception of Western science that underlies computer science. These exclusions tend to discourage intelligent and capable women who wish seriously to pursue academic and professional careers in computing.

There appears on the forefront, however, factors encouraging women's participation in computing. Changes that offer reassurance *for women* include an increase in the number of female academic role models at all levels of math and science education, better computer science education at all levels of education, and stronger support in educational contexts for younger girls at the primary and secondary levels of math and science.

Socialization and Computer Science

An analysis of socialization and computer science is assisted by Keller's social study of modern science. Keller examines the social structuring ramifications of the perpetuated fiction of the male possessing objectivity, reason, and mind, with the female exhibiting a stronger affinity to subjectivity, feeling, and nature. This artificial gender partition has led to perceptions that continue to manifest themselves in the worlds of the sciences and computing.[18] Our examination of the social beliefs about women in computing will focus particularly on social control beliefs.

Control Beliefs About Women's Social Participation in Computing

Although the findings note some obvious sociological concerns such as sexual harassment and male chauvinism, the social control belief findings repeat the same factors noted in the earlier section about control beliefs and knowledge construction. This finding is particularly important because it points out that the knowledge construction of computer science seemingly more fully discourages females than do the sociological factors.

The data suggest that both knowledge construction and socialization are major intertwined problems, and point to a primary concern for a restructuring of knowledge construction linked with socialization. To summarize, the findings call for strategies within all levels of computer science education and the computing industry to alter the "time-loss factor," to search out alternative approaches to computing along with those based on western logic, and to build the "critical mass factor," which includes both female leaders and mentors to complement male leaders and mentors.

In contrast to the clear analysis of control beliefs pointing to dissuading factors related directly to knowledge construction, this same category had much to offer in findings that encourage women's participation in computing. Although the findings brought forward social-based suggestions, they overwhelmingly reinforced the understanding that the most encouraging factors come from changes taking place in a linking of knowledge development with socialization in computer science education: computing in elementary school with girls swayed by parents and teachers to participate, more encouragement from parents and educators from elementary levels upward for girls to take part in math and science, and more female teachers and professors in the math, science, and computer science. Encouraging social control beliefs include the breaking of gender stereotypes, parents encouraging their daughters to enter computer-based careers, and awareness by engineering and computer professionals concerning social conditioning and structuring in their professions. Young girls encouraged by parents, the education enterprise, and by industry, and with broader choices in computer hardware and software, could establish a comfortable presence in a more inclusive world of computing and develop the computing prior-knowledge and computing prior-experience expertise that begins to diminish the "time-loss factor."

New Connections in Art and Technology

If there exists, as suggested, discrimination against women in the theory and practice of computer science, what does this have to do specifically with developing theory and application in the emerging electronic arts? Applications of developing electronic technologies to the arts embody the underlying epistemological structure of computer science that forms the technologies. The application of a particular electronic technology is not an act of neutrality, for it embraces the epistemological structure of that technology[20] and passes on implanted discrimination.

Looking particularly to applications of electronic technologies in the arts, let me mention three contemporary challenges raised by this hidden discrimination. First, the electronic arts suffer from a lack of validity because there exists little theory shaping the contexts and discourses about the electronic arts. As Simon Penny of Carnegie Mellon University points out, our "[s]ystems of communication and structures of power have changed yet the worldviews and critical systems that operate in many of our institutions are pre-electronic, often pre-industrial."[17] Traditional art historical methodologies are a case in point; they fail to address the emerging electronic arts. We face the challenge of developing theory that is ethical in its forming and embraces understandings of the theory and practice of computer science; understandings of the arts including aesthetics, history, criticism, and production; combined with our daily living contexts involving power constructs managing electronic-based information and equipment access, and including gender, class, and ethnic concerns.

Second, in our theory building we can take account of analyses of biases against women in computing and address these living problems. Current computer science must be reshaped if arts applications are to move beyond their restrictive and imposed parameters.

Third, we live in a world shaped by information technologies, and the shaping of our culture by these technologies begs for theoretical direction. A shaping of theory that adequately informs the arts and an emerging digitally shaped culture calls for a convergence of separate discourses in the arts: a joining of 1) the evolution of the electronic-based arts and 2) radical theories of representation that have dominated recent arts discourse. Timothy Druckrey astutely points out that "theories of interactivity must be joined with theories of discourse."[5] The changes I am suggesting for the theory and practice of computer science and for theoretical forming in the arts call for a communal effort by those involved in the reworking of theory in these particular disciplines and fields and in their interdisciplinary crossings. We stand at a point where emerging theory can connect the partitioned concerns of arts discourse, electronic technologies, and our everyday living contexts.

In conclusion, let us return to the question that initiated our discussion. Does computer science in its theory and practice embody discrimination against women, and if so, how does embedded discrimination work itself out in arts applications? Social study and historical analysis along with survey and interview data strongly suggest that there exists discrimination against women in computer science and that it is passed on to arts applications. By addressing specific sources of gender discrimination in the theory and practice of computer science linked to developing theory in the emerging electronic arts, we can begin to get women wired in ways that include, rather than exclude, and create new traditions that place human beings and our communal well-being in the foreground of ongoing developments in electronic computer-based technologies.

Acknowledgements

This research is funded by the Social Sciences and Humanities Research Council of Canada and Redeemer College. I thank Ohio State University faculty members Wayne Carlson, Carol Gigliotti, and Douglas Kerr for their helpful assistance along with Redeemer College colleagues Elaine Botha, Hugh Cook, David Koyzis, Danie Strauss, and Jitse van der Meer. Research assistants Michelle ter Haar, Deborah Kranendonk, and Anthony Morbey also are thanked.

References and Notes

1 Barriers to Equality in Academia: Women in Computer Science at MIT (Cambridge, MA: MIT, 1983).

2 Bowers, C.A. The Cultural Dimensions of Educational Computing: Understanding the Non-Neutrality of Technology (New York: Teachers College Press, Columbia University,1988).

3 Crawley, F.E. and Koballa, T.R. "Attitude Research in Science Education: Contemporary Models and Methods. Science Education 78, 1994, pp. 35-55.

4 Dreyfus, H.L. and Dreyfus, S.E. Making a Mind Versus Modeling the Brain: Artificial Intelligence Back at the Branchpoint. Daedalus 117, 1988, pp. 15-43.

5 Druckrey, T. Revising Technology in T. Druckrey, ed. Iterations: The New Image (Cambridge, MA: MIT Press, 1993), pp. 29-36.

6 Frenkel, K.A. Women and Computing. Communications of the ACM 33, 1990, pp. 35-46.

7 Gardner, H. The Mind's New Science (New York: Basic Books, 1995), pp. 1-27.

8 Gigliotti, C. and Morbey, M.L. Taking Responsibility for the Social Relations of Science, Technology, and the Electronic Arts in Arts Education. Paper presented at the American Educational Research Association annual meeting, April 1995.

9 Haugeland, J. Artificial Intelligence: The Very Idea (Cambridge, MA: MIT Press, 1986), pp. 15-45.

10 Keller, E.F. Reflections on Gender and Science (New Haven: Yale University Press, 1985).

11 Keller, E.F. Secrets of Life, Secrets of Death: Essays on Language, Science and Gender (New York: Routledge, 1992).

12 Kerr, D. Personal interview, December 12, 1994.

13 Morbey, M.L. Gendered Technology for Art Education: The Case Study of a Male Drawing Machine. Arts and Learning Research 10, 1992-1993, pp. 88-100.

14 Morbey, M.L. Aaron: Portrait of the Young Machine as a Male Artist. Revue d'art canadienne/Canadian Art Review XX, 1993, pp. 130-139.

15 Morbey, M.L. Women, Discriminating Computer Technology and Visual Arts Education: How Might It Be Different? in D. Gregory, ed. Art Education and Technology Anthology (Reston, VA: National Art Education Association, in press).

16 Pearl, A., ed. Women in Computing. Communications of the ACM 38, 1995, pp. 26-82.

17 Penny, S. Introduction. Critical Issues in Electronic Media (Albany, NY: State University of New York Press, 1995), p. 2.

18 Spertus, E. Why Are There So Few Female Computer Scientists? Technical Report 1315 (Cambridge, MA: Massachusetts Institute of Technology Artificial Intelligence Laboratory, 1991).

19 Turkle, S. and Papert, S. Epistemological Pluralism: Styles and Voices Within the Computer Culture. SIGNS: Journal of Women in Culture and Society 16, 1990, pp. 128-157.

20 Van der Meer, J.M., ed. Facets of Faith and Science, Vol. 2, The Role of Beliefs in Mathematics and the Natural Sciences: An Augustinian Perspective (Lanham, MD: The Pascal Centre for Advanced Studies in Faith and Science/University Press of America, 1996).

21 Women Undergraduate Enrollment in Electrical Engineering and Computer Science at MIT (Cambridge, MA: MIT, 1995).

Contact
MARY LEIGH MORBEY

Redeemer University College
777 Highway 53E
Ancaster, Ontario, Canada L9K 1J4
gmorbey@machl.wlu.ca

Digital Bayou

Digital Bayou

The Louisiana Bayou is not far from here, in every direction, and cyberspace surrounds us. Both are rich and complex ecosystems, with rapid speciation and a wealth of evolving lifeforms coexisting and competing for resources and a chance to reproduce. At the Digital Bayou, you'll find some of the most advanced interactive and graphics technologies on the planet, co-existing in one vibrant space. We've tried to create a place teeming with the nutrients for fresh ideas and for the explosive growth of new commercial, research, and entertainment life forms.

Networked virtual societies, innovative interfaces, precompetitive technologies, scientific visualization, teleoperation, and fun are linked by meandering walkways, punctuated by gathering spaces, and protected by canopied nets. Activity migrates from exhibit to stage to screens. People can engage in conversation with the experts, then meet in a comfortable setting to reflect on their experience in a scenic getaway.

We hope the Digital Bayou will inspire you to examine how technology continues to rapidly transform the possibilities in our lives. This is a world where edges and boundaries mesh and weave. Where the connections mean more than the individual elements. And, not coincidentally, where natural plant life and digital systems are equally simple and sacred, yet silently bewildering.

We know the culture's expectations outpace even the fastest technological advancements at SIGGRAPH 96. Many attendees know how it feels to realize that the public is bored with a high-tech future we will never finish inventing. It's our responsibility to invent interfaces for that future that leverage our abilities without isolating our spirits.

We want to thank our selection committee for their generous commitment of time and expertise, and the SIGGRAPH 96 committee for their enthusiastic support. Intervista Software has provided extensive technical and moral support. Special thanks go to Marisa Shumway, Marshall Pittman, and Jeff Mayer. The most thanks Brian can give goes to Trish Blau. Maggie Rawlings and Nam June Paik have been a continual source of inspiration.

Digital Bayou Committee

Co-Chairs
BRIAN BLAU
Intervista Software

CLARK DODSWORTH
Osage Associates

Committee

COCO CONN
Digital Circus

ZAN DIENER
Z Designs

RICK HOPKINS
Side Effects Software

WARREN KATZ
MäK Technologies

MICHAEL LIMBER
Angel Studios

JEFFREY MAYER
beyond_space

JODY VAN METER
Entertainment Ink

KENNETH PIMENTEL
Sense8 Corporation

J. MARSHALL PITTMAN

MARISA SHUMWAY
Intervista Software

JON SNODDY
GameWorks

CHRISTOPHER STAPLETON
MCA Recreation Services

Artificial Dolphins

Artificial Dolphins was initiated in October 1994, to enable human communication with an artificial life form in a virtual reality environment. Its dolphin-style simulated life forms are animated using physically-based modeling. Real-time computer graphics; motion planning; simulation of water, foams, sprays, and bubbles; and 3D sound bring the dolphins to life. This type of real-time communication and interaction with artificial life in a synthetic environment implies new and exciting opportunities in entertainment, education, and communication.

The artificial dolphins swim autonomously in a virtual sea. They approach the audience or perform stunts, according to their own motivations. They can also respond to audience signals generated with a special light pen. If the dolphins want to achieve the requested goal, such as "approach the audience" or "jump," the goal is divided into sub-goals, then automatically executed in real time. The audience can ask the dolphins to "come here," "twist," "jump through a ring," etc.

Two cameras are used for video input, and the 3D position of the light pen is calculated using computer-vision techniques. The trajectory of the light pen is used for gesture recognition. It can recognize 16 different gestures in real time. The gestures are simple, so it is relatively easy to learn how to communicate with the dolphins. But because their reactions depend on their internal status, the dolphins do not always respond the same way to a specific gesture.

Vocalizations of dolphins, splash sounds of jumps, etc., are represented by an in-house 3D sound system called SOUND CUBE. The apparent positions and velocities of the sounds it generates, in conjunction with the real-time animation, create realistic 3D sound effects.

NORIHIRO MUNEMASA
MASANORI MIYOSHI
KEN ANJYO
NOBUHIKO MATSUKUMA
HIROAKI TAKATSUKI
MANABU YANAGIMOTO
GEORGE NISHIYAMA
NOBUHIRO SEKIMOTO
HARUO TAKEDA

Contact
TSUNEYA KURIHARA

Central Research Laboratory
Hitachi, Ltd.
1-280 Higashi-koigakubo
Kukubunji-shi
Tokyo 185 JAPAN
+81.423.23.1111
+81.423.27.7754 fax
kurihara@crl.hitachi.co.jp

Inline

UNIX / External

Bayou Sauvage is a dramatic, entertainment-oriented implementation of the most advanced multi-user virtual world applications. It is a multi-vendor, multi-platform demonstration of an emerging civilian standard derived from the Distributed Interactive Simulation (DIS) protocol used in military simulation training.

Approximately 20 different vendors of computer hardware, software, and systems are participating in a common game across the SIGGRAPH 96 Exhibition floor and Digital Bayou. Participants start in different vehicles from different locations and race across the Bayou to reach a crashed drug smugglers' plane. They encounter active and passive obstacles, not the least of which is each other, in a complex 3D world.

This demonstration highlights some of the major features of DIS, including interoperability between vastly different hardware platforms (PCs to high-end image generators), vastly different software renderers (VRML web browsers to real-time visual simulation packages), and vastly different 3D visual file formats (VRML to OpenFlight). It is a harbinger of the revolutionary 3D multi-user synthetic environments that will soon hit the Web.

Over the last decade, this robust Department of Defense-sponsored open standard for networked synthetic environments has been refined to provide a very-large-scale, multi-user platform for military training, video games, and Web-based environments.

3D Terrain Database
ROSALIE BIBONA
Lockheed Martin Real 3D Company

DIS-Compliant VRML Web Browser
TONY PARISI
Intervista Software

VR-Link DIS Software
WARREN KATZ
MäK Technologies

3D Modeling Tool
PAUL MLYNIEC
MultiGen Inc.

3D Visual Models
Viewpoint Datalabs

Simulation Consulting
FARID MAMAGHANI

Contact
WARREN KATZ

MäK Technologies
185 Alewife Brook Parkway
Cambridge, Massachusetts 02138
USA
+1.617.876.8085
+1.617.876.9208 fax
wkatz@mak.com
http://www.mak.com

This installation is an immersive virtual environment about landscape and public gathering spaces. In part, it is a study contrasting the familiar with the foreign, over space and over time. In part, it is an attempt to re-awaken our sense, essence, and sanctity of place through place-scale media. And it is a simulation of what public media spaces could be like in the context of live, high-bandwidth global networking.

The installation consists of stereoscopic video projection on a large screen (with the same field of view as the cameras), four-channel surround audio, a simple input device (to choose location and time of day), and a 16-foot floor that rotates in sync with the imagery. The intention is to create the illusion that the image is rotating rather than the audience, and ultimately to act as a provocation to reconnect one's sense of place to the ground.

The camera system deployed two 35mm motion picture cameras (for high spatial resolution) mounted side-by-side (for stereopsis) with wide-angle lenses (for immersion) and synchronized 60 frame-per-second motors (for high temporal resolution), which generated unrivaled fidelity. The system was mounted on a motor-driven tripod that rotated once per minute. The entire system weighed 500 pounds but was built for travel.

The camera gear, along with a pro-DAT audio recorder, went around the world to film public gathering places in the cities on UNESCO's "Endangered List." Of the 469 UNESCO-designated World Heritage Sites, 18 are further designated "in danger," of which four are (or were) cities: Dubrovnik (Croatia), Timbuktu (Mali), Angkor (Cambodia), and Jerusalem (which UNESCO places in the Hashemite Kingdom of Jordan). Relying on local collaboration, a single spot was selected at each site from which to film several times throughout the course of a day.

Supported by
INTERVAL RESEARCH CORPORATION

Special thanks to
UNESCO WORLD HERITAGE CENTRE

Produced for
CENTER FOR THE ARTS YERBA BUENA GARDENS

Contact
MICHAEL NAIMARK

Interval Research Corporation
1801-C Page Mill Road
Palo Alto, California 94304 USA
+1.415.842.6061
naimark@interval.com
http: //www.interval.com/projects/benowhere.html

Inline

UNIX / External

CHRISTOPH DOHRMANN

AMEE EVANS

GILLES TASSÉ

Cypress Adventure is an interactive experience set in a cypress swamp. Participants interact with the background and navigate through the experience singly or in pairs. The experience is based on optical, non-contact, real-time tracking of markers placed on the participants' hands. It consists of two components: the Chase sequence, for one or two participants, and the Design sequence, for one participant at a time.

In the Chase sequence, participants navigate through the swamp at accelerating speeds, searching for increasingly elusive clues in an attempt to get "home free" before time runs out. They wear black gloves, to which have been affixed four IR-reflective markers. The left glove acts as a throttle, while the right glove serves as a rudder. After the system is initialized (which takes 5-10 seconds), a static background appears. Then participants use their hands to operate the controls of a virtual fanboat as they navigate through the swamp.

Visual cues indicate which pathways are appropriate or inappropriate. Selection of inappropriate pathways reduces a participant's score, while selection of appropriate pathways increases it. The background is, of course, updated as participants navigate. The experience is strictly time-limited because the implicit pace of the adventure (passage of time) gradually accelerates, so that within a fixed interval, one or both participants either attain the goal (home free) or become entangled in the virtual background. Participants' actions are displayed in real time on a projection screen driven by an SGI.

In the Design sequence, participants use a three-dimensional palette to enhance and manipulate an initially fixed set of backgrounds representing the bayou atmosphere. They select a tool from the palette by pointing with their left hand, then use their right hand to select a color or object to which the tool will be applied. Customized, more exciting backgrounds with vivid colors or novel orientations (such as horizontal buildings) can be created and then integrated as backgrounds into a subsequent Chase sequence.

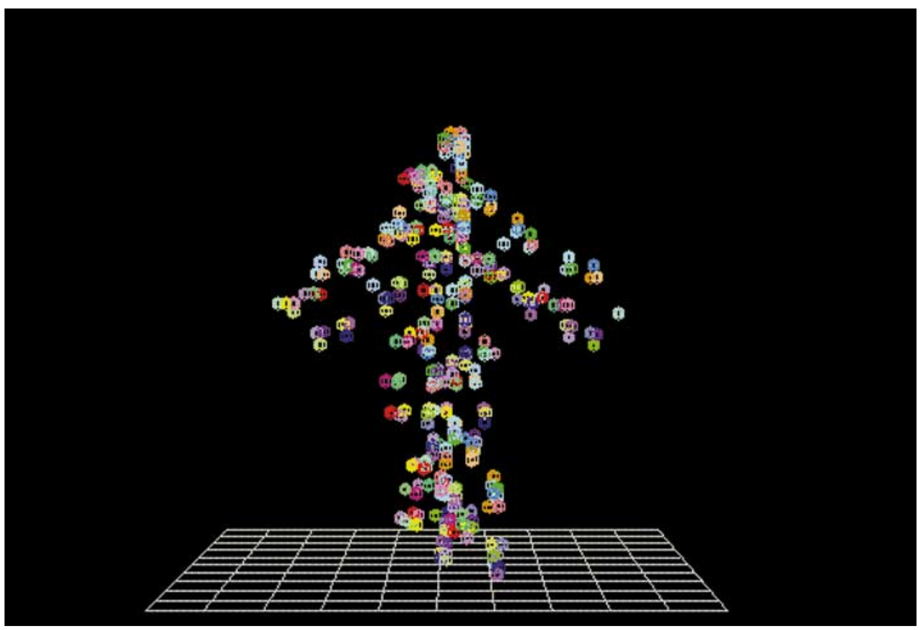
Contributors

Technical Director
MARK REYNOLDS

MURRAY TAYLOR
Microprose Co.

Contact
DEAN WORMELL

Adaptive Optics Associates, Inc.
54 Cambridgepark Drive
Cambridge, Massachusetts 02140 USA
+1.617.234.0131
+1.617.864.1348 fax
dean@aoa.aoainc.com



Deceiving Manipulation with a Palmtop Display

A new concept in unencumbered VR interfaces, this system involves integration of a large-screen video projector's "window" into a virtual world, a robot arm that functions as a three-axis haptic display, and, mounted to the end of the arm, a small color LCD video monitor and a magnetic position sensor.

The small LCD monitor serves as both a moveable viewer for close-ups of the virtual world and a remote manipulator. Using this repositionable display, users can center a 3D object and select that object by a single click of the button built into the back of the display. Haptic, audio, and visual feedback allow users to determine which object they have selected. All the objects have weight and can be rearranged within the tabletop area. To release an object, and return the display to its "viewer" state, users click the button again.

Without using processor-intensive simulation of detailed physical phenomena, this system readily simulates rigid surfaces, such as tabletops, and provides collision detection and simulated magnetic attraction Though the system does not accurately simulate a real environment, the method efficiently deals with the discrepancy between the real and virtual environments, and enables natural, precise manipulation.

For the Digital Bayou, the system presents an exercise that involves constructing a "Mikoshi" (a Japanese portable shrine). In this exercise, a more traditional glove-like VR manipulator device allows attendees to compare both ease of use and learning curve. There are practical applications for this system in the 3D CAD market and the emerging 3D authoring market.

Contributors

HARUO NOMA
Y. KITAMURA
T. MIYASATO
F. KISHINO

Contact
HARUO NOMA

ATR-Media Integration & Communication Research Laboratories
2-2 Hikaridai
Seika-cho, Souraku-gun
Kyoto 619-02 JAPAN
+81.774.95.1211
+81.774.95.1208 fax
noma@mic.atr.co.jp

Inline

UNIX / External

Digital Dixieland is a multi-player jam session designed to allow creative people with different levels of musical expertise to play together in a high-quality musical/graphical environment. It is a location-based example of what an online musical/social experience might look and sound like in the near future. It features a jukebox full of funky tunes, a Control Booth where aspiring DJs can create a real-time remix, a Graphic Generator for manipulating the visual ambiance, and a Trigger Tree for multimedia soloing. Up to six people can play together at any given time, and the results of their input are seen and heard in "near real-time" by everyone within the space.

The experience is implemented using time-stamped MIDI codes to transmit player events and musical information, and multiple client-based sequencers that play back the experience with a slight lag in absolute time while keeping the relative parts perfectly in sync. Just as musicians in a band play different instruments, participants in *Digital Dixieland* play different yet complementary roles. Musical beginners can play "DJ": choose a song from the jukebox, and then select pre-recorded samples. The underlying system implements phrase-based timing quantization, so a smooth mix is guaranteed. More advanced musicians can solo: use their voice or any instrument to add their own MIDI compositions to the jukebox.

There are also several layers of graphics controls. Beginners can play "Graphics DJ": use the Graphics Generator control panel to affect parameterized color-cycling background graphics in real-time. More adventurous souls can "solo" on the Trigger Tree: a fallen log embedded with a variety of MIDI triggers that control real-time graphic events in the foreground. These solo graphics are engineered to respond to the intensity, placement, and repetition of the graphic soloist, and can be set up to trigger sounds as well.

Contributors

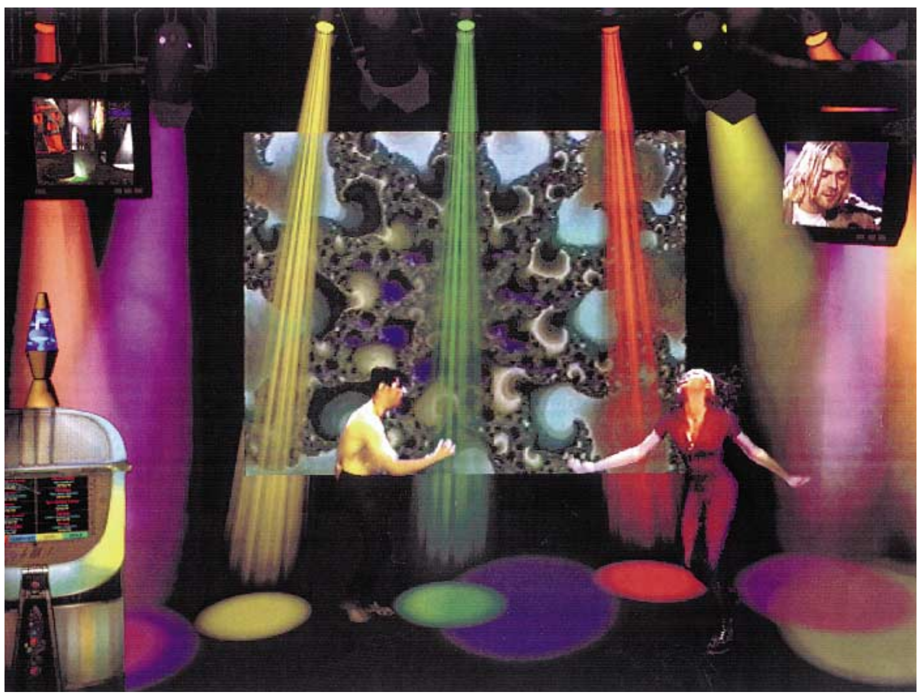
Producer/Designer
A.J. KIM

Programming and Design
JOSEPH SZUECS

Interactive Graphics
TONY GRANT

Contact
AMY JO KIM

4016 Farmhill Boulevard #103
Redwood City, California 94061 USA
+1.415.369.0313
amyjo@naima.com
http://www.naima.com

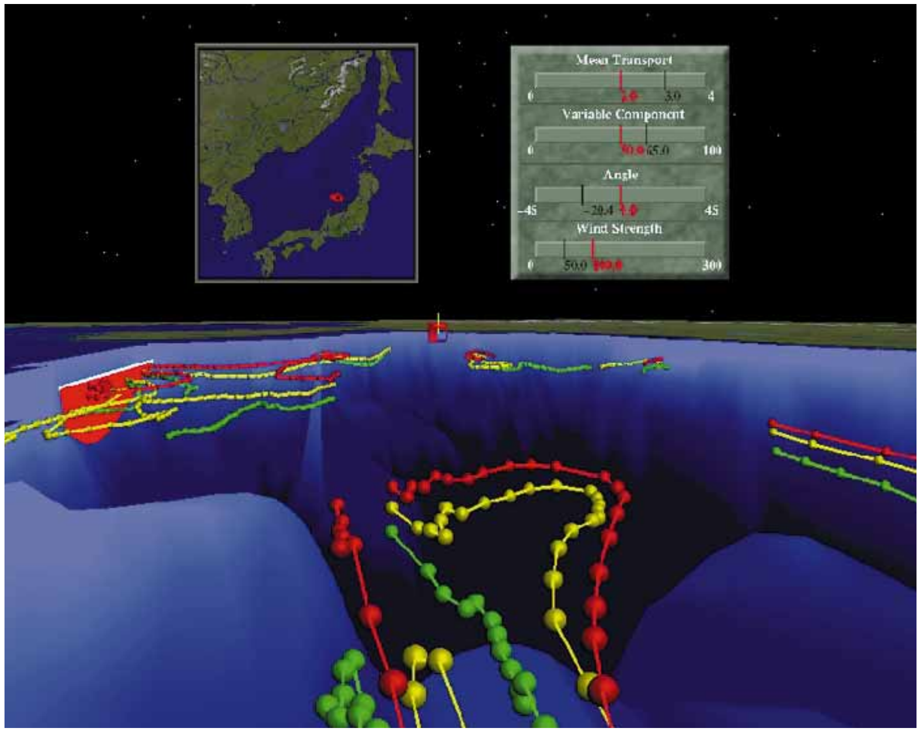


Distributed Scientific Visualization of Ocean Models

This prototype simulation enables operational or exercise planners to test various scenarios prior to initiation of the operation. The application is highly adaptable to training operations via interactive "fly-throughs" of ocean simulations, including interactive control of the ocean model itself.

Participants use a virtual reality boom driven by a Silicon Graphics RE 3 engine. Imaging is also displayed on two Silicon Graphics MAX IMPACT workstations. In addition, a continuous animation describes the evolution of the science of oceanography. In the virtual reality displays, 3-D images of the ocean include undulating surfaces, small tracer balls flowing through space, tub-like surfaces representing currents and eddies, and graphics from raytraced surfaces. The interactive circulation model is user-controlled via keyboard and certain parameters that affect the model's solutions, such as current strength and wind force, are controllable.

These techniques for incorporating high-resolution bathymetry and acoustic backscatter imagery into a simulated ocean floor visualization will eventually be coupled with oceanographic models to produce volumetric/parameter-selectable visualizations of the water column, and the results will be exported into an interactive bathymetric/topographic flythrough/flyover.



Contributors

DAN WILLIAMS
ROBERT KNESEL
STEPHEN LINGSCH
HOUSTON COSTOLO III
PETER GRUZINSKAS
CASS EVERITT
JACK BREYER
MICHAEL ADAMS
GARY HERRING
LUDWIG GOON
Naval Oceanographic Office

DAN FOX
PETER FLYNN
Naval Research Lab

ROBERT MOORHEAD
KELLY GAITHER
SCOTT NATIONS
Mississippi State University

Contact
ROBERT M. KNESEL

Naval Oceanographic Office
1002 Balch Boulevard
Stennis Space Center, Mississippi
39522-5001 USA
+1.601.688.5126
+1.601.467.1001
rmk@msrcnavo.navy.mil

Dr. *Jackt's Robot Island* is an interactive three-dimensional application. Its intent is to provide an entertaining environment to showcase the technology of VRML 2.0 and CosmoPlayer. Players explore each of these modular application spaces in order to discover "The Secret of Dr. Jackt's Robot Island."

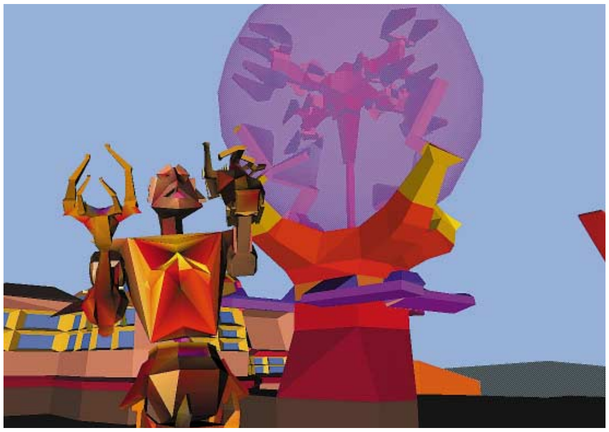
Background: In the late 1950s, a young researcher by the name of Vernon Jackt grew restless with his place at the Robotics Lab of Generic Electric. After years of trying to get his innovative work in robotics implemented or even noticed, he hit a brick wall. "The world NEEDS mechanized modularity," he railed. "These FOOLS can't see that!" His work was truly revolutionary. Dr. Jackt was indeed a genius. He had conceived the first totally modular being, an artificially intelligent robot that could be made from semi-intelligent parts, so he decided to create his own Robot Island.

To discover the secret of *Dr. Jackt's Robot Island*, players must complete five modules, each divided into a separate island that the player explores. The player starts the game on the main island, where Dr. Jackt constructed his Robot Lab, where players construct unique robots that act as avatars. From there, players move on to the second island, where the Electro Field Generator lies dormant and must be reactivated. On the third island, players discover The Fountain, a database designed to serve up complex behaviors to the robots. Players must activate the database so that their avatars can drink from The Fountain, which allows them to perform complex functions. On the fourth island, an ornate statue stands in a grand space. There is more to this story, but it cannot be revealed, for it is the secret of *Dr. Jackt's Robot Island*, waiting to be discovered.

Dr Jackt's Robot Island is an open VRML 2.0 application that can be loaded and run on any VRML 2.0-compliant browser.

Contact
CLAY GRAHAM

Silicon Graphics , Inc.
2011 North Shoreline
MS 14L-912
Mountain View, California 94039
USA
+1.415.933.2495
+1.415.390.6060 fax
clay@sgi.com
http://reality.sgi.com/employees/clay/



d-rhum (drum room) is a room that responds to the presence and movement of its occupants. Computers translate sensor data into commands to motors. The motors stretch, push, strike with mallets, and move sections of the walls or the walls themselves. The walls are built of malleable materials, such as latex, with embedded deformations and a variety of rhythmic sonorities and vibrations. As participants enter and move around the room, they notice that the walls move, change in shape, and emit percussive sounds. Upon further investigation, they discover that they can interact with aspects of the movements and sounds of the room by coordinating their movements. They are encouraged to play the room like drums with random and deliberate movements around the sensors.

The spatial configuration of d-rhum and its participants is dynamic and constantly evolving. Within this fluid environment, participants begin to see that their personal boundaries are fuzzy. As they move, so do the walls, blurring the traditional limited expectations of an architectural space. Certain combinations of movements cause deformations and sound emissions, but it is never clear which movements generate which reactions.

PETER FRANCK
Pratt Institute
industrial strength, inc.

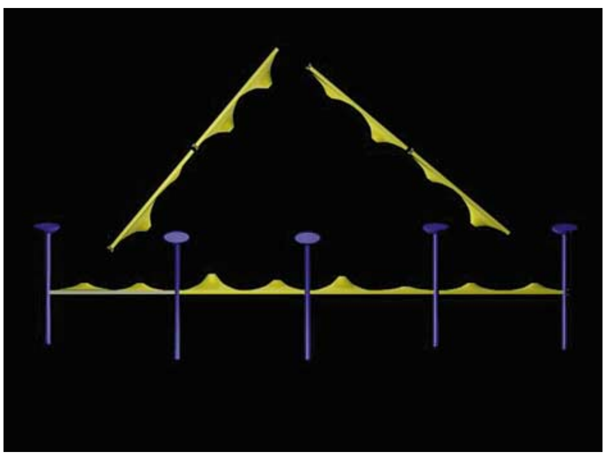
DANIEL SCHWARTZ
RomeBlack, Inc.

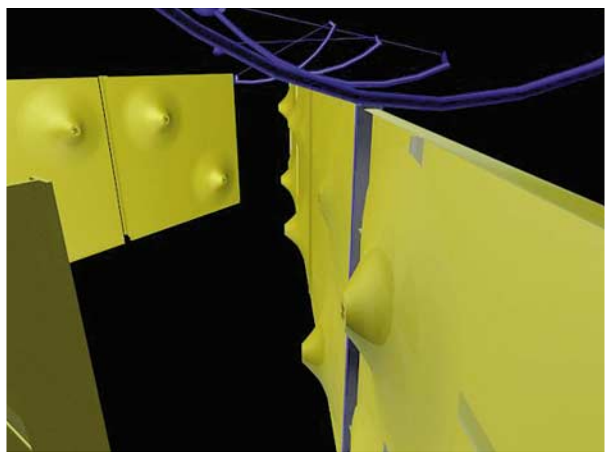
Contributors

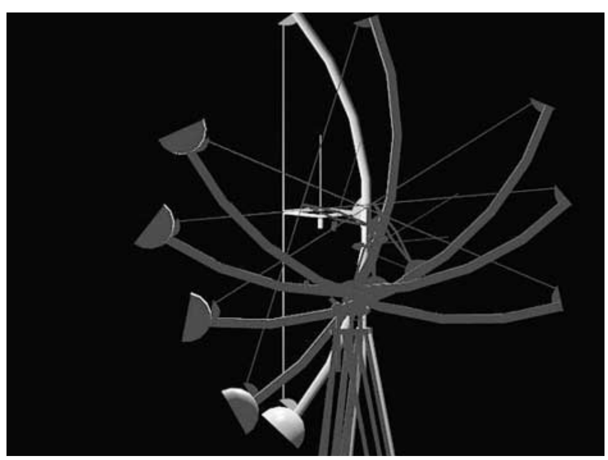
EUGENE LEBEDEV
RICHARD HUGHES

Contact
DANIEL SCHWARTZ

RomeBlack, Inc.
180 Varick Street Suite 12A
New York, New York 10014 USA
+1.212.727.9735
+1.212.727.9546 fax
dls@romeblack.com

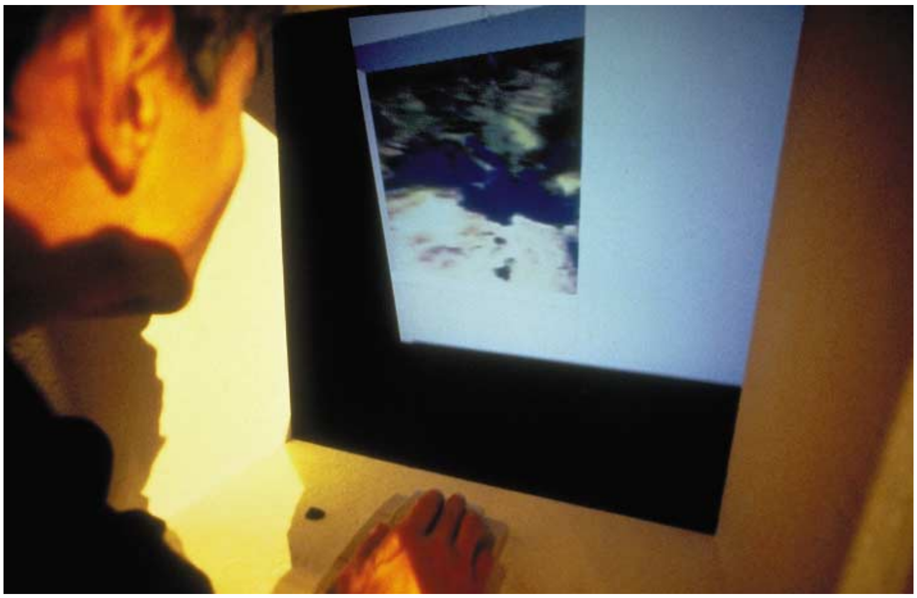






This project is distributed across several locations at SIGGRAPH 1996. For a complete description of *Global Interior Project*, please see The Bridge: SIGGRAPH 96 Art Show, page 26.

MASAKI FUJIHATA
Keio University



For the last three years, the *Guerrilla Gallery* has provided a rich interactive experience for works-on-paper artists and the entire SIGGRAPH community. This working atelier is a digital imaging studio, with manufacturer-donated equipment on which image makers can experiment using their own files.

Though digital printing is not a new idea, we are still challenged by the technical complexity and aesthetic questions that arise when attempting the conversion from digital file to digital print. Most significantly, the *Guerrilla Gallery* is a place of "common ground" where image makers from all fields can share the excitement of an open studio environment. This is truly a crossroads, where the science and art communities meet and merge their mutual concerns.

This year's studio features Summagraphics and WACOM tablets and a full range of printers. Color Xerox systems are sponsored by Radius/Splash. Jon Cone of Cone Editions Press again provides his expertise in the IRIS printing area. Showcased technology includes the large-format ENCAD printer, which accepts a wide range of papers, and the Alpha Mercs Phase Change Printer, which prints liquid wax with an encaustic effect on any surface up to .75 inches thick and 4 feet by 8 feet. Under the supervision of the "Unique Editions Artists Collaborative," *Guerrilla Gallery* visitors collaborate on a work to be printed on the Alpha Mercs at full size at the end of the workshop. Access to *Guerrilla Gallery* equipment is scheduled daily on a first-come, first-served basis.

Contact
PATRICIA JOHNSON

401 69th Street, 8G
Miami Beach, Florida 33141 USA
+1.305.868.1206
+1.305.237.1850 fax
patjoh@aol.com

Force feedback, a new technology that is about to revolutionize the video game industry, is not just an incremental improvement over existing computer game paradigms. It is a fundamental step forward that will unleash an entirely new mode of "feel-based" gaming interactions.

Force feedback brings video games to the next level of play, moving beyond mere sights and sounds and immersing users in a physical reality that is as compelling and satisfying as the real world. Traditional game controllers can only track a user's actions. They cannot convey physical interactions. For example, a player using a traditional controller can command the motion of a race car or a spacecraft through simple manual gestures, but when the user's actions cause the spacecraft to collide with an asteroid or cause the race car to slam into a barrier wall, a standard interface has no means of conveying such physical information back to the user.

With a force feedback joystick, impacts with asteroids are not simply shown visually on the screen. POW, they are displayed physically as real forces imparted on the user's hand. When a player slams a race car into the barrier wall, a force feedback joystick produces a physical sensation that represents the collision. When a player drives a race car into a bale of hay, SQUISH, the joystick produces a sensation that represents a collision with a soft surface. If the race car goes off the road and onto the dirt, the joystick produces sensations that represent driving over a rough texture. When a player wields a sword or swings a racquet, a force feedback system can realistically emulate weight, inertia, and dynamic impacts.

Haptic Challenge is a multi-user gaming environment focused on the sense of feel. Two players engage in a 3D game scenario in which they propel a virtual puck at the opponent's goal. They are armed with virtual paddle controllers in a full dynamic simulation that allows them to feel the puck interacting with the paddle with such realistic fidelity that they can actually take advantage of fine manual dexterity to put spin on the puck. Force feedback is so central to this experience that the game simply could not be played without it.

While force feedback has traditionally been restricted to research labs and high-end applications, Immersion Corporation's I-FORCE hardware architecture has dramatically reduced the costs of the technology and brought it to arcade games and home computer games.

Contributors

LOUIS ROSENBERG
SCOTT BRAVE
DEAN CHANG
BRUCE SCHENA
KEN MARTIN
ADAM BRAUN
MIKE LEVIN

Contact
LOUIS ROSENBERG

Immersion Corporation
2158 Paragon Drive
San Jose, California 95131 USA
+1.408.467.1900
+1.408.467.1901 fax
louis@immerse.com
http://www.force-feedback.com

H*apticWeb* is a World Wide Web client that enables users to feel the rigidity or weight of virtual objects. It is based on a six-degree-of-freedom force feedback device, HapticMaster, which applies three-degree-of-freedom force and three-degree-of-freedom torque at the user's hand. The user can manipulate and feel virtual objects by holding a knob at the top of the HapticMaster.

Haptic interface research is expanding. In most cases, the software and hardware systems are designed to work together, which restricts application development. In this research, the software is divided into two modules: the device driver for force display and the "renderer" of the virtual object. Currently, "rendering" refers to generation of visual images, but in virtual environments, hardness, weight, viscosity, and other forces must also be rendered. In *HapticWeb*, force feedback is rendered from a VRML dataset.

The research team has also developed an authoring tool for *HapticWeb*. The rigidity and weight of virtual objects are represented by 3D icons. Users can change the rigidity or weight by manipulating the size of the icons.

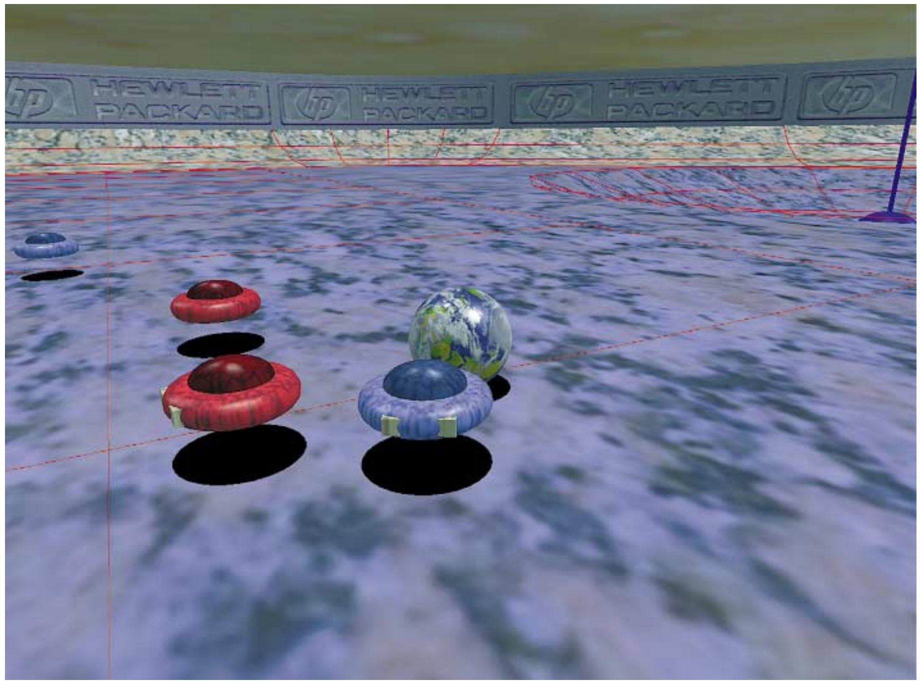
Contact
HIROO IWATA

Institute of Engineering Mechanics
University of Tsukuba
Tsukuba Science City, Ibaraki
Prefecture
305 JAPAN
+1.81.298.53.5362
+1.81.298.53.5207 fax
iwata@kz.tsukuba.ac.jp

Interactive Multiplayer HoverBall

HoverBall is a demonstration of a collaborative, networked, three-dimensional environment. Two teams of four players each compete to win an air-hockey-like game by maneuvering their craft to turn, accelerate, jump, and brake under full physical simulations of acceleration, collision, friction, and inertia. Players collaborate with teammates via their actions in the arena and two-way audio communications.

HoverBall is implemented on top of an object-oriented, generalized simulation server. Utilizing a layered client-server protocol, it supports multiple-player clients with wide varieties of graphics and audio capabilities. Physics, user interaction, graphical display, and audio feedback are all independent objects computed by the server. Player clients accept simulation data at varying rates and convert them into experiences ranging from fully immersive visual/audio environments to typical workstation graphics displays.



Collaborators

ROSS CUNNIFF
NORMAN GEE
Hewlett-Packard Company

Contact
ROSS CUNNIFF

Hewlett-Packard Company
3404 East Harmony Road, MS 74
Fort Collins, Colorado 80525 USA
+1.970.229.4644
cunniff@fc.hp.com

Interview, an interactive multimedia program for interviewing young children who may have been sexually abused, provides a structure that helps children tell their stories verbally or non-verbally. It also assists the interviewer by providing a framework of questions and an easy-to-use system for taking notes and tracking the children's selections. Because it simplifies the interview process, gives the interviewer more time to focus on the child, and supports non-verbal communication, this interviewing method enhances children's abilities to communicate a greater amount of vital information.

Interactive multimedia gives children pictures and sounds that help create a safe, familiar, and supportive environment for responding to questions and telling their story. The program has been tested and revised three times over a six-year period to assure consistent, unbiased results suitable for use as evidence in court. Extensive research was conducted with both children and interviewers to design an application that is appealing to children without being leading or too playful.

Interview is expected to be used by professionals involved in the interviewing process: police officers, psychologists, social workers, attorneys, psychiatrists, and others. It contains a court-reporting tracking system that provides a permanent record of each interview. All edits are maintained separately from the original.

Interview was supported by grants from the National Institute of Mental Health's Small Business Innovation Research program and contributions of hardware and software from numerous computer companies.

Producer, Project Director
KAREN LITTMAN

Technical Director
DAVID HUMPHREYS

Art Director
RANDY MARSDEN

Research and Content Consultants
LUCY BERLINER
Harborview Medical Center

BEN SAUDERS
Medical University of South Carolina

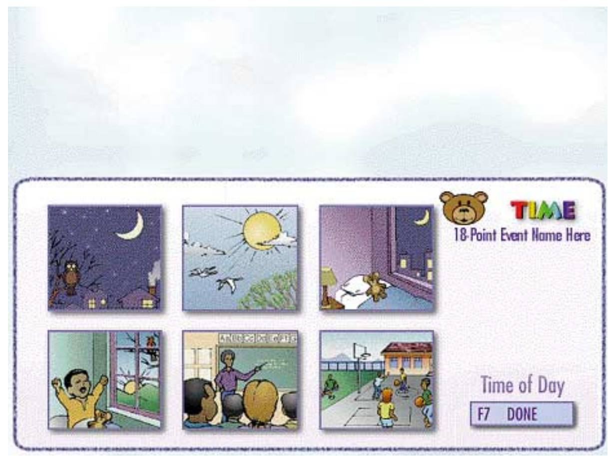
KATHLEEN FALLER
University of Michigan

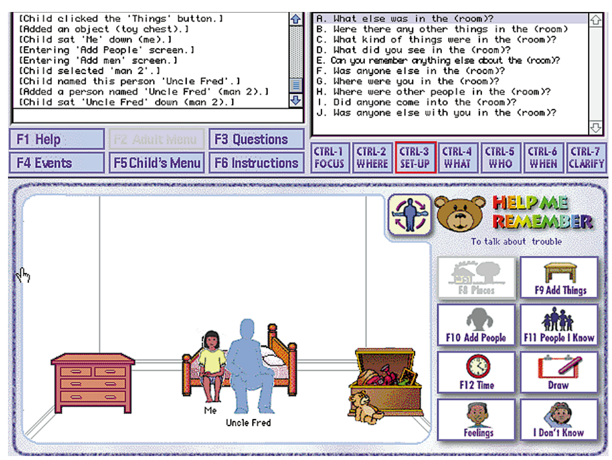
JON CONTE
University of Washington

NANCY STRETCH
Office of the District Attorney
San Francisco County

Contact
KAREN LITTMAN

Morphonix
26 Laurelwood Court
San Rafael, California 94901 USA
+1.415.456.2561





JOURNEYS by TeleCommunity is an ongoing project in which young students from around the world express ideas, art, and insights in a dialogue about personal journeys, through multimedia imagery, QuickTime movies, and network exchange. They "travel" via the Internet to collaborate on journeys of peace, of the heart, of meaning, of the future. Through shared animations and interactive multimedia pieces, Internet videoconferencing, Web browsing and editing, email exchange, templating, and ftp transfer, they communicate and integrate experiences and perceptions of the world and each other. The premise "think globally, act locally" is realized in this undertaking, as students expand their conceptual views of the world while they create in their studio settings. "Acting locally" takes on new implications as expansive telecommunications technologies give local actions a direct global resonance.

Participants include students working at the Duquesne University School of Education (their computer academy), in Pittsburgh, Pennsylvania; students at the Israel Museum Youth Wing in Jerusalem; students associated with the Henie Onstad Art Center in Høvikodden, Norway; and students in Amman, Jordan, in association with and assisted by the Royal Institute for Interfaith Studies and the Amman Baccalaureate School.

Contributors

ROBERT DUNN
Arc Vertuel, Inc.
Duquesne University

MELANIE CARR
Carnegie Museum of Art

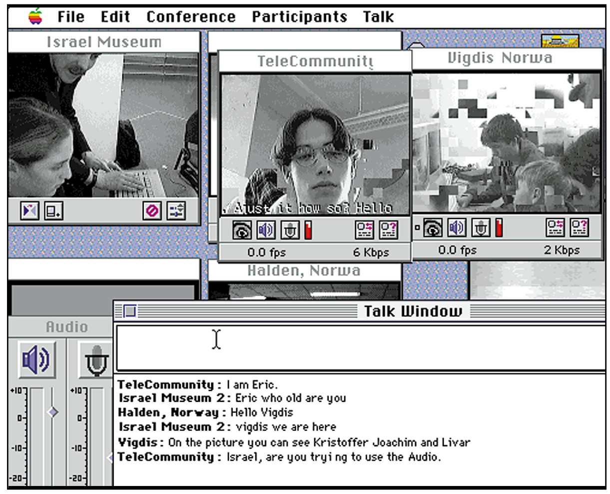
NATHAN FULLERTON
Carnegie Mellon University

SUSAN HAZAN
SERGIO FERDMAN
Israel Museum Youth Wing

VIGDIS HOLEN
Henie Onstad Art Center

HIRONOBU YAMAMOTO
SANNO College

JEFFERSON HAN
Cornell University



Contact
ROBERT DUNN

Arc Vertuel
111 The Oaks
Pittsburgh, Pennsylvania 15215 USA
+1.412.781.1563
+1.412.781.8138 fax
rd1s+@andrew.cmu.edu

Good virtual reality environments can embed meaning primarily or partially in their immersive and interactive qualities. These interactive works engage the viewer in experiences that break the traditional boundaries of art by actively involving participants in rich, compelling environments. Virtual reality can extend the traditional arts by encouraging this active participation in the creative process.

In *Neither Here Nor There*, VR becomes accessible to digital artists through the ImmersaDesk, a projection-based, drafting-table-sized virtual reality system. The size and position of the screen provide a sufficiently wide field of view that the viewer feels fully immersed in the visual scene. Head tracking allows the participant to experience a first-person view as opposed to the third-person view experienced with other visual media. The user's hand position is tracked by the "Wand,", the main control device with which participants manipulate the scene. Additionally, the desk is surrounded by a directional sound system.

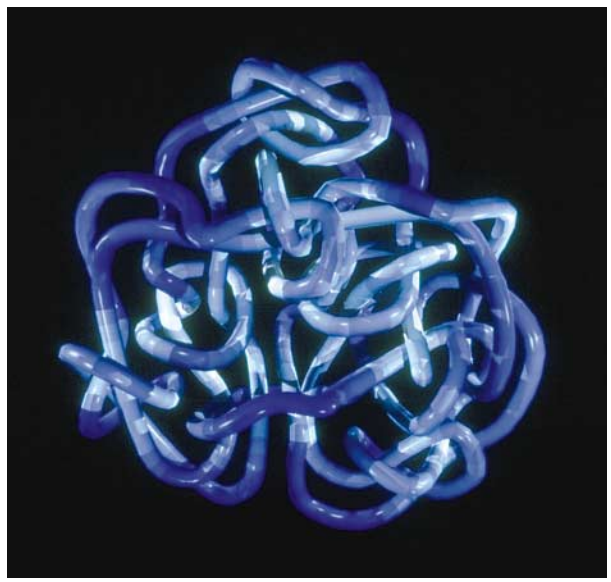
The ImmersaDesk system creates an evocative setting for viewers to experience and participate in the worlds that unfold before them. It merges aesthetic and conceptual concerns with high-resolution display technology, network connectivity, and advanced visualization techniques. Moreover, participants at remote sites have the opportunity to explore the same worlds and interact with each other.

Neither Here Nor There is a series of collaborative events utilizing advanced networking software and hardware to interconnect the Immersadesk environments in The Bridge: SIGGRAPH 96 Art Show, an Immersadesk installed in the Digital Bayou, and a CAVE at the Ars Electronica Center in Linz, Austria. The title of this collaboration reflects the ethereal status of cybercommunication in current society. It also characterizes the notion that while on a bridge you are between locations. It is a state of being that is time-based, where geographic location (space) is irrelevant.

These virtual reality environments create a new form of communication that offers a presence not ever experienced in traditional forms of communication. By digitally connecting to other VR platforms, users experience the potential of networked interactivity. The use of interactive applications opens a window into the probable future of high-end telecommunications.

Contributors

JIM BARR
KEITH BEU
JEFFERY BROOKS
DREW BROWNING
ORLANDO CARNATE
TOM COFFIN
ALAN CRUZ
MAREK CZERNUSZENKO
GREG DAWE
MARGARET DOLINSKY
TERRY FRANGUIADAKIS
ROBERT GRZESZCZUK
YUN-WEN HSU
JOE INSLEY
KA LEUNG JARK
ANDREW JOHNSON
LOUIS KAUFFMAN
JOHNNY LAWSON
JASON LEIGH
BOR-TYNG LIN
GARY LINDAHL
DEBRA LOWMAN-MELCHIONDA
ERAN MILLER
ALAN MILLMAN
DAVE PAPE
KYOUNG PARK
SO YEN PARK
CLAIRE PRUCHER
MAGGIE RAWLINGS
JOE REITZER
MARIA ROUSSOS
DAN SANDIN
GRIT SEHMISCH
VINCENT SHINE
MARCUS THIEBAUX
BOVORNPOL THIENSIRI
SELENA TRAMAYNE
CHRISTIN A. VASILAKIS
MARGARET WATSON



Contact
DANIEL J. SANDIN

Electronic Visualization Laboratory
University of Illinois at Chicago
851 South Morgan Street,
Room 1120
Chicago, Illinois 60607-7053 USA
+1.312.996.3002
+1.312.413.7585 fax
dan@evl.eecs.uic.edu

Exposure therapy involves exposing subjects to anxiety-producing stimuli while allowing the anxiety to attenuate. These stimuli are generated through a variety of modalities including imaginal (in which the subject generates stimulus via the imagination) and in vivo (in which the subject is exposed to real situations).

Acrophobia (the fear of heights) is characterized by marked anxiety about high places, avoidance of heights, and interference in normal every day activities. Based on an initial subjective evaluation of what types of height situations cause anxiety in a patient, a therapist using an in vivo graded-exposure approach to treating acrophobia would arrange therapy sessions in which the patient goes through a process of exposure and adjustment to those situations (habituation). Patients begin with less threatening situations and gradually work their way up a hierarchy of more anxiety-producing experiences. For example, therapy sessions might begin by looking through a third-floor window with the therapist present. In subsequent sessions the patient might move up to a window on the tenth floor. Other common locations for in vivo therapy are external stairways, balconies, bridges, and elevators.

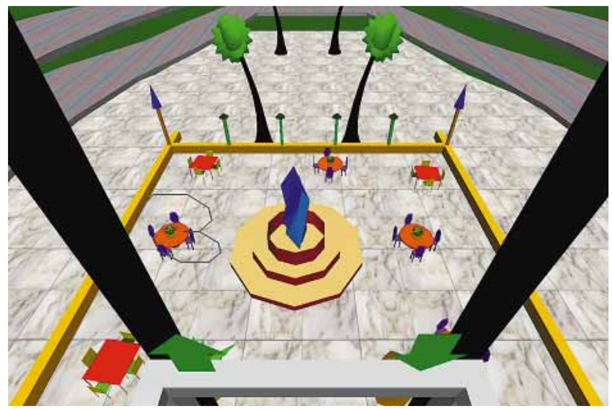
In virtual reality exposure, instead of confronting a real environment or imagining the fearful situation, the patient confronts a virtual environment containing the feared stimulus. In the first controlled study of virtual reality exposure therapy in the treatment of a psychological disorder, a team of therapists and computer scientists demonstrated that it can be very effective in reducing acrophobic anxiety and avoidance of heights, and in improving attitudes toward heights.

In this project, acrophobia is treated with four different scenarios: a glass elevator, a canyon with bridges, balconies overlooking a city, and an airplane flight. In the elevator, the subject controls a glass elevator inside a 49-story building. In the bridges scenario, the subject can move from a boat floating on the water to any of three bridges above. In the balconies, the subject moves between outside balconies attached to a building overlooking a small city. And in the Virtual Airplane project, the subject is taken aboard an airplane to experience a virtual flight in varying weather conditions. The experience can be changed from a smooth flight to a rough flight and even a rough landing. The Virtual Airplane features extensive sound effects. It also provides out-the window animation based on both modeled objects and aerial photography.

Contributors

ROB COOPER
BENJAMIN WATSON
LARRY F. HODGES
GREG NEWTON
DREW KESSLER
DOUG BOWMAN
Georgia Institute of Technology

BARBARA O. ROTHBAUM
Emory University School of Medicine



Contact
ROB COOPER

Graphics Visualization and Usability Center
Georgia Institute of Technology
801 Atlantic Drive
Atlanta, Georgia 30332 USA
+1.404.894.8787
+1.404.894.0673 fax
cooper@cc.gatech.edu

Plasm: Yer Mug offers passers-by an electronic mirror complete with cultural distortions. A seething artificial-life community behind the looking glass lines up to track and interpret the life forms that inhabit our side of the mirror.

The wandering Digital Bayou attendee steps up to the counter, or hops up on a stool. Gazing into the mirror behind the bar, visitors may notice that their reflection adapts to their reaction to it. Their visage is being served up via short-order evolution, as fleets of genetic automata mutate onward, surviving by the nature of the visitor's engagement. Over the course of this evolution, the visage always tracks its participant tightly, maintaining the intimate kinship usually reserved for one's own shadow or reflection.

The physical setting of the installation takes its cues from the Late Night Cafe. Across the diner's counter, the aroma of fresh-brewing coffee encourages people to lean in and see what's going on. Force-sensing resistors embedded in the counter and stool pedestals inform the system of each visitor's body attitude. A camera perched in front of each stool frames the seated visitor, feeding live video for evaluation by the system; *Plasm: Yer Mug* "mirrors" this input through a continuous, synthetic graphic display rear-projected at life size behind the counter.

Real-time video tracking and feature extraction is used to corral a fleet of semi-autonomous geomorphs on the screen. Each geomorph presents its own 3D rendered form, animated according to its own independent behavior. Corralling ensures that the fleet of geomorphs tracks the participant's face and motions tightly, to maintain reflection relationship.

The geomorphs themselves are models drawn from a stockpot of cultural idioms and reflections, encoded as a sequence of genetically-mutable factors. Four different artists have developed their own families of geomorphs, exploring divergent vocabularies of form, motion, sound, reactivity, and statement. While each geomorph "blueprint" describes an interesting envelope of appearances and behaviors, evolutionary techniques are applied during the performance to explore within the parameter space and extrapolate outward from it. Participants shepherd this mutating construction with their body language, instrumented via their video-tracked envelope and force-sensing devices on the countertop and seating. The geomorphs they leave behind are not likely to be the same ones the artists introduced. Geomorphs that survive will emerge frequently during SIGGRAPH 96.

This installation is motivated by a quest for increasingly accessible virtual exchanges. The reality is that today's society is becoming more and more computerized. Over the course of this cultural transformation, person-to-person contact is becoming increasingly stylized. *Plasm: Yer Mug* instills a playful/personal air into the user/computer mix, seeking an antidote to the structured formality of so many modern interfaces.

Three distinct approaches are explored in this investigation.

- "Meeting at the cafe" evokes a shared experience, an ingredient that is usually missing in today's encounters with machines.
- The explicit abstraction of facial expressions challenges the one-to-one mapping of conventional machine controls.
- Body-contact sensing allows for a multiplicity of simultaneous inputs, a dramatic divergence from the "one-hand-tied-behind-your-back," mouse-based interactions that are commonly assumed.

Each of these approaches illuminates a subtle difference from today's typical GUI encounter. Taken together, they invite participants to think twice about their daily routines with their machines.

Contact
ROB MYERS

Silicon Graphics, Inc.
2011 North Shoreline Boulevard
M/S 14U-982
Mountain View, California
94039-7311 USA
+1.415.933.3446
rob@set.engr.sgi.com

Projec(tions) is a collaboration by a small group of students and faculty at Parsons School of Design focused on creating an interactive map of New York City that represents the new television medium and human interface of the future.

The conspicuous challenge cultivated by emerging technologies remains the human (analog) to computer (digital) interface. What should the "look and feel" of new digital environments look and feel like? The answer to this question demands a qualitative response. It requires an understanding of the capabilities of a billion instructions per second in micro-processors and a billion more instructions per second calculated by the five human senses.

It is an issue of how one communicates "usable" information to the other. After all, most information is rendered "useless" and unperceived by our conscious minds. We naturally censor the white-noise in our environment. The euphoria of a million web broadcasters may be a boon to information access until one feels the weight of a global population announcing "Hello World!" in digital sight and sound.

The sensory hunt is on, and our nervous systems are the prey.

Projec(tions) designs and constructs the infrastructure of an immersive interactive environment based on the challenges and opportunities provoked by new media. An urban environment is used to reconstruct an interface and content-delivery mechanism that is naturally sensory-rich and interactive.

A metropolis inherently displays the characteristics that describe the "look and feel" of new digital experiences. Urban environments are already multimedia-ready, inherently multi-user, spatially immersive, and repositories of an infinite layering of information and content. (Are there not "eight million stories in the naked city?") City inhabitants and tourists alike navigate this environment extracting and censoring the data they need. While one user seeks explicitly defined facts, another can wander through sight and sound appreciating the knowledge gathered by casual perception.

The intention of *Projec(tions)* is to generate a digital infrastructure that blurs the boundaries between interface and content, human and computer, and broadcaster and receiver. The required interface to contain and organize near infinite bytes of content becomes transparent by creating a mediator that is equally sensory-rich. To further this natural interface, literal translations of the human body are used to aid in navigation and comprehension of content. A digital language is mapped by an anthropomorphic one. Our infrastructure is open to scripts of images and sound, allowing users to deposit their own messages and meaning.

The *Projec(tions)* interface is intended for use with a variety of input devices and numerous audio/visual components. It does not move toward mastery of one technology over the other. The paramount concern here is the relationship of human perception augmented by digital environments.

Collaborators

CHRISTOPHER GRANT KIRWAN
EDWARD LUCERO
LINA KUTSOVSKAYA
CHEYNEY ROBINSON
ROBERT KIRWAN
RICHARD DAY
JAMES MORRISON
ROBERT "BOB" SEETIN

Special Thanks to:

CHARLES OLTON
RICHARD YELLE
SVEN TRAVIS
JOHN SWEENY

Contact
RICHARD YELLE

Parsons School of Design
66 Fifth Avenue
New York, New York 10011 USA
+1.212.229.5885
+1.212.929.2456 fax
Yeller@newschool.edu

Inline

UNIX / External

Riverworld

Riverworld has been designed to demonstrate a way in which people from geographically separate locations will be able to meet and interact in virtual environments. Using ISDN, LAN, other network technologies, and high-resolution immersive peripherals, attendees enter a recreation of a 19th century Louisiana paddle-steamer. Wearing a head-mounted display, they adopt a "facial" avatar, which allows them to explore different rooms within the synthetic environment without the encumbrances of human form. In addition to real-time interaction with other avatars, objects, and characters in four different rooms, participants are entertained by live comedians, musicians, and entertainers from Virtuality's offices in the U.S., Europe, and Japan.

This project demonstrates what Web entertainment applications could look like within the next 18-24 months. Many leading market research and industry analysts expect such applications to drive the next tier of Web growth.

Contact
JON WALDERN and SHEILA COX

Virtuality Technology Inc.
4005 Miranda Avenue, Suite 150
Palo Alto, California 94304 USA
+1.415.843.3700
+1.415.843.0711 fax
JonW@Virtuality.com

R*.O.V.E.R. II* is an extension of a simple telepresence project. Based on the original Rover Onyx chassis, *R.O.V.E.R. II* has a new head featuring stereo vision and independent head tracking. The operator wears a VR helmet that allows an immersive 3D telepresence experience. A mechanical tracker coupled to the VR helmet allows the cameras on *R.O.V.E.R. II* to mimic the user's viewpoint, and the human-machine interface allows easy movement of the *R.O.V.E.R. II* mobile platform. A two-way voice link allows the operator to communicate with anyone near the *R.O.V.E.R. II* platform.

"Telepresence" means to tele-port your presence to another location, which can imply immersion in a computer-generated virtual reality experience. With *R.O.V.E.R. II*, it implies using electronic and mechanical devices to teleport your presence to another location in the real world.

Contact
D.J. MERRILL and DAVID RUSSELL

Institute for Simulation and Training
University of Central Florida
3280 Progress Drive
Orlando, Florida 32826 USA
+1.407.658.5513
+1.407.658.5059 fax
deej@vsl.ist.ucf.edu
drussell@vsl.ucf.edu

Relying upon a proprietary, real-time, 3D rendering engine, *San Francisco Rush* runs a four-point, physically correct driving model descended from the award-winning Hard Drivin' model. The model has been refined in police simulators over the past several years, and now, with the introduction of new hardware, Atari Games Corporation unveils a completely new experience in driving simulation. Push your driving skills to the limit as you race the clock and up to seven competitors through the streets of San Francisco.

The game offers a choice of eight different high-end, production sports cars, ranging from the Acura NSX to the Saleen SR Mustang. Each player chooses a car, a race course (beginner, intermediate, expert), and type of transmission (manual or automatic). The steering wheel provides force feedback through a patented motor assembly tied directly into the car model, which allows the player to actually feel every bump in the road and every counter-force as the car skids around corners.

In addition to the main controls, a series of secondary controls improves the flexibility and playability of the experience. A "CD changer" button allows the player to choose among four different styles of soundtrack or none at all. Three view buttons control where the player views the action from: the driver's seat, overhead as if from a helicopter, or in front of the car as if a camera is strapped to the bumper. An abort button helps the player out of dire situations.

Producer
JOHN RAY

Lead Programmer
ALAN GRAY

Programmers
JIM PETRICK
JOHN GERACI

Lead Animator
SPENCER LINDSAY

Animators
MIKE PRITTIE
ROB ADAMS

Composer
GUNNAR MADSEN

Contact
CAMERON PETTY

Atari Games Corporation
675 Sycamore Drive
Milpitas, California 95035 USA
+1.408.434.1783
+1.408.434.3910 fax
petty@agames.com

Fakespace Music presents a completely new type of virtual reality experience. In our worlds, sound is the fuel used to drive a continuous stream of stereoscopic graphics, all in temporal harmony with the music. It's like nothing ever seen before: a "music video" where the user is completely immersed and free to explore a world generated by music.

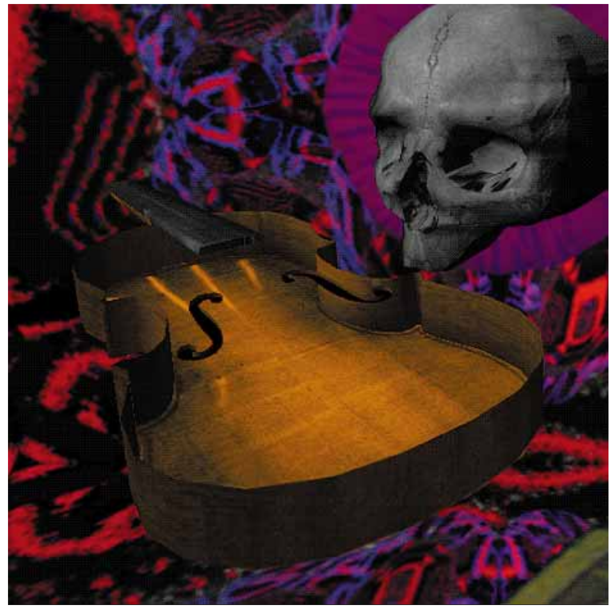
With the understanding that music is more than just audio, Fakespace Music developed the Soundsculpt Toolkit, a software interface that allows the world of music to communicate with the graphical elements of virtual reality. Cues extracted from either live or recorded music create geometry and control object behaviors within a virtual world. Three-dimensional objects respond in sync with the music, creating a rich, multi-sensory experience.

By analyzing music for standard audio characteristics such as rhythm and frequency, information is extracted and mapped onto individual objects within the virtual environment, along with associated behaviors. Mapping decisions are based on the aesthetic requirements of directors and designers. This provides for visually active, immersive environments in which virtual objects behave in real-time correlation with the music, effectively extending the influence of music from our ears to our eyes.

In *Soundscapes*, visitors are totally engulfed as they enter the virtual world. These pieces are presented using either a Fakespace BOOM 3C or the new Fakespace PUSH high-resolution stereoscopic viewer with a Silicon Graphics Onyx Reality Engine2. It can also be configured with Immersive Entertainment Kiosks, which are ideal for public venues and provide for greater audience throughput.

When the music begins, visitors are transported into a virtual world in which the graphics are completely controlled by what they hear. Objects gyrate in real time to the tempo of the music. Kaleidoscopic mandalas pulse to the beat. Geometry appears and moves about to the rhythm. Melodies draw colorful trails across the sky as the visitor moves through the virtual space, discovering new visions at every turn of the head.

This music-driven virtual reality opens up several possibilities for new types of artistic and entertainment experiences, such as fully immersive 3D "music videos" and interactive landscapes for live performance. Artists can create landscapes that transform in direct relationship with their live music. Location-based entertainment centers will be able to offer these experiences as a new form of entertainment for their guests.



Inline

UNIX / External

Contributors

MARK T. BOLAS
NIKO BOLAS
CHRISTIAN GREUEL
IAN MCDOWALL

Contact
CHRISTIAN GREUEL

Fakespace Music
4085 Campbell Avenue
Menlo Park, California 94025 USA
+1.415.462.5830
greuel@xian.com
http://www.xian.com/fsm/fsm.html

Video tele-conferencing lacks personal mobility and autonomy; we cannot control what we see or hear. Even with cameras in every room, the experience lacks the spatial continuity of a walk around the building.

In *Space Browsers*, this problem is solved by a small helium blimp with a video camera and other equipment mounted on it. This tele-mobot *Space Browser* immerses the user in a remote world by providing real-time remote environmental information, continuity of motion, and user control of that motion. These elements provide the cues necessary to stitch together an entire experience into a coherent picture of a building and its occupants. Users can also communicate with the remote world and its inhabitants using this system.

A *Space Browser* has several motors directly connected to small propellers, a video camera, a microphone, a speaker, and a radio transmitter. The payload is less than a pound. At the other end of the radio link, a computer links the blimp's sensors and actuators to the network.

The remote "pilot" uses a Java applet, running within any Java-supporting Web browser, to deliver continuous motion commands to the blimp. The pilot observes the real world from the viewpoint of the blimp, listens to sounds and conversations within its close proximity, and communicates by simply speaking to the computer. Many people can experience this version of tele-embodiment simultaneously, since users who are not in direct control of the blimp can passively view the live video and audio as a pilot navigates.

Space Browsers provide a new means of remote human interaction. They allow users to easily travel vast distances from their computers and interact in a familiar manner with others. Because they are inexpensive, *Space Browsers* have the potential to provide ubiquitous telepresence.

Contact
ERIC PAULOS and JOHN CANNY

Electrical Engineering and
Computer Science
University of California at Berkeley
387 Soda Hall
Berkeley, California 94720-1776 USA
+1.510.642.8149
+1.510.642.5775 fax
paulos@cs.berkeley.edu
jfc@cs.berkeley.edu
http://vive.cs.berkeley.edu/blimp/

Night falls over New Orleans, and even the most scientific minds feel the touch of the supernatural forces that permeate the bayou. Voices emanate from nowhere, visions of Voodoo spirits appear and then vanish again, leaving us to wonder: Were they ever there at all?

Just as you begin to feel your sanity slipping away, someone calls to you. You turn. There before you lies the entrance to The Botanica Virtual. The proprietor stands in the door, beckoning you to enter. Inside, Voodoo herbs and talismans sit side by side with computers and other pieces of high technology. Pointing out that Papa Legba has always understood the instruments of communication, she gestures toward what appears to be a Carnival mask, though the cable snaking from the mask to the floor suggests something different altogether. “We all wear masks,” she says, “but this one is different. This mask may conceal your face, but it will open your eyes to a world as old as this one, which has only recently begun to accept visitors.”

Created by the IMPROV Project at NYU’S Media Research Lab, *Spirits of the Bayou* uses technologies that produce distributed 3D virtual environments in which human-directed avatars and computer-controlled agents interact with each other in real time through a combination of procedural animation and behavioral scripting techniques. The lab is also exploring multi-modal interaction paradigms combining traditional keyboard and mouse inputs with speech and gesture recognition in conjunction with various forms of presentation, including 2D and 3D displays. The system is intended to operate over local and wide-area networks using standard Internet protocols so that anyone with access to the World Wide Web can develop or participate in fully interactive, vital experiences.

Artistic Direction
ATHOMAS GOLDBERG

IMPROV Software
KEN PERLIN
ATHOMAS GOLDBERG

Conceptual Research & Design
DANIEL VEGA
MICHAEL DOUGHERTY
PAM GARTRELL
MICHAEL CRUMPTON

3D Modelling & Animation
SETH PIEZAS
DENNIS MEJILLONES
TODD AKITA
JAMES MORRISON
AUSTIN LEE

Prop/Set Design & Construction
DUANE WHITEHURST
EDWARD LUCERO
FRED HANSEN
JAMES MORRISON

Music & Sound
CLILLY CASTIGLIA
ERIC SINGER
SABRINA LIAO

Additional Software
ERIC SINGER
MEHMET KARAUL
TROY DOWNING
JON MEYER
DANIEL WEY

Administration
CYNTHIA ALLEN
MARY TIERNEY
STUART PILTCH
PATRICIA RINALDI
STEVE COONEY

Production Manager
DUANE WHITEHURST

Contact
CYNTHIA ALLEN

NYU Media Research Lab
715-719 Broadway Room1227
New York, New York 10003 USA
+1.212.998.3478
+1.212.995.4122 fax
cynthia@play.cs.nyu.edu
http://www.mrl.nyu.edu

Tenochtitlan: The Clash of Empires

The year is 1519. Hernán Cortés and his army of Spanish conquistadors are riding toward the island city of Tenochtitlan, the center of the Aztec empire. Montezuma, despite a series of foreboding omens, has decided to receive Cortés and provide the hospitality for which he and his people are known. Now, nearly 500 years later, we join the conquistadors as they tour the sacred walled precincts at the ceremonial heart of Montezuma's realm.

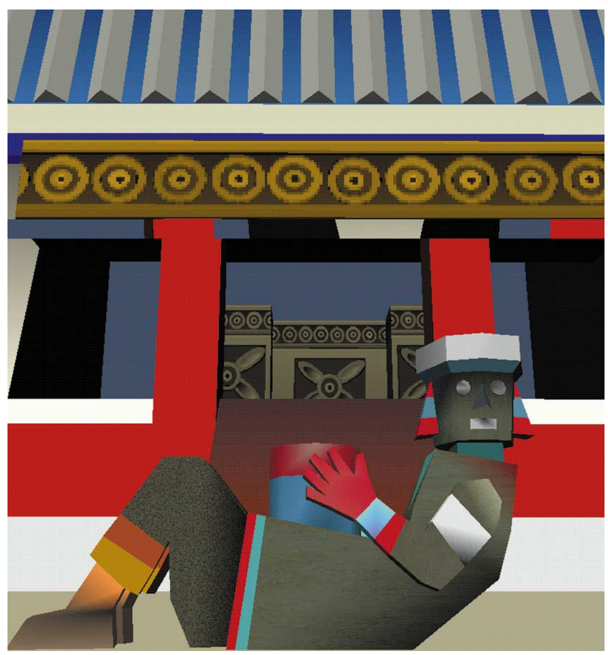
Tenochtitlan: The Clash of Empires is a Web-site-based, three-dimensional, interactive multimedia tour built in VRML 2.0. To follow the narrative, the visitor travels from one landmark to the next by clicking on tour icons. At each significant spot, there are further models, background, and historical information to be explored. The site is not just a still, silent monument to the past. Ambient sounds drift through the island air, birds fly overhead, and people glide along the lake in boats. Pop-up web pages and audio clips narrate the encounter between the two cultures, culminating at the top of the Great Temple, facing the shrines of the most sacred gods. There, the course of history is set as Cortés, disturbed by the pagan idols and appalled at the sight and stench of sacrificial blood, insults the Aztec gods and attempts to replace them with the sign of the cross.

Contributor

RIKK CARREY
Founder, VRML Group
Silicon Graphics, Inc.

Contact
DELLE MAXWELL

Silicon Graphics, Inc.
Building 14U-MS 982
2011 North Shoreline Boulevard
Mountain View, California 94043
USA
+1.415.933.4545
+1.415.933.0255 fax
delle@sgi.com




In the place of the colored darts,
of the painted shields,
is Tenochtitlan...
There open their corollas

V*ibescape* is a virtual audio real-time experience that enables SIGGRAPH 96 attendees to create unique soundscapes in 3D space. The virtual environment produces 3D localized audio in four-channel surround sound, creating a totally immersive audio environment. Attendees can lose themselves while standing, sitting, or lying on the Sonic Wave Floor, a carpeted matrix of subwoofers that delivers deep tissue massage.

Attendees control tracking and determine which sounds are played, placed, mixed, and composed. The soundscapes are based on algorithms dealing with physics, gravity, artificial intelligence, and above all, the user.

Contributors

Director
JOE REITZER

Interface Design Support
MORTEZA GHAZISAEDY
JIM BARR

Contact
JOE REITZER

Electronic Visualization Laboratory
University of Illinois at Chicago
727 West 18th Street
Chicago, Illinois 60616-1021 USA
+1.312.996.3002
+1.312.413.7585 fax
reitzer@evl.eecs.uic.edu

Virtual Kabuki System

Facial expressions play important roles in natural human communication. To realize human-like agents, sometimes called avatars, in virtual environments, it is essential to detect facial expressions from an image in real time and reproduce them in the 3D face model. This project demonstrates a real-time facial expression detection and reproduction system and reproduces those expressions in 3D models of Kabuki actors.

The system consists of three main modules: face modeling, facial expression detection, and reproduction. In face modeling, a 3D model is created with a wireframe that approximates the face shape through a set of small triangular patches. The wireframe model maps the color and texture of the face. In this new method of facial reproduction, 3D measurement data for different facial expressions generated by the main facial muscles are exploited to convert shape changes into deformation data of the 3D face model.

In *Virtual Kabuki System*, not only facial expressions but also body actions are reproduced in a Kabuki actor's very artistic and exotic 3D human model. Participants are asked to wear a helmet for facial expression detection. To detect body actions, stereo thermograph cameras track significant points of participants' bodies. According to the detected facial expressions and body actions, the simulated actor performs Kabuki on a large high-definition screen. Participants perceive themselves as Kabuki actors performing traditional Japanese drama.

Contributors

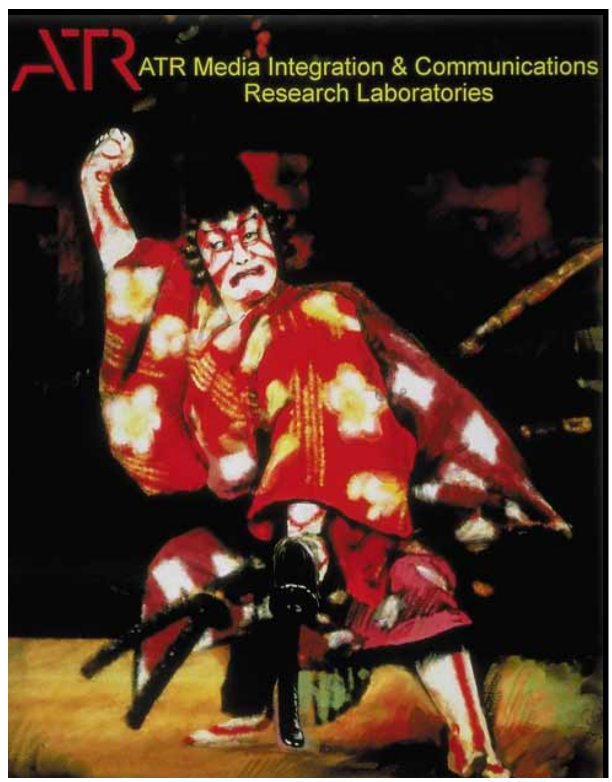
K. EBIHARA
J. KURUMIZAWA
J. OHYA
F. KISHINO
R. NAKATSU

Contact
KAZUYUKI EBIHARA

ATR Communication Systems
Research Laboratories
2-2 Hikaridai
Seika-cho, Soraku-gun
Kyoto 619-02 JAPAN
+81.774.95.1211
+81.774.95.1208 fax
ebihara@atr-sw.atr.co.jp

Inline

UNIX / External



In the SmartScene immersive scene-assembly environment, this virtual playspace is assembled into an ever-changing and infinitely variable world. Several players at various physical locations share a common, collaborative space for assembling these scenes.

After a brief session in a separate training station, the player dons a headmount and Pinch gloves and interacts with the scene through virtual snap cursors positioned between thumb and forefinger. The cursors appear as blue jacks embedded in red balls. By grabbing the fabric of space with one or both hands, users simultaneously translate, rotate, and scale themselves through the scene. With other pinch gestures, they can grab objects in the scene and interact with a toolbox that floats over the palm of the left hand.

Lego parts are selected by browsing in a kit library through simple pinch gestures in the toolbox. These parts are then stretched and snapped into the scene. Any number of players can simultaneously grab and stretch a single part. They can also paint parts and assemblies from a palette of appropriate colors and textures that is also accessible through the toolbox.

Spatial audio and ambient music plays a strong role in enhancing the experience, and live video feeds of the other users located in the MultiGen and SGI booths in the SIGGRAPH 96 Exhibition are accessible from the toolbox through scalable video titles. Infinite Reality-supported particle systems are also incorporated into the experience.

Contributors

MultiGen Inc

PAUL MLYNIEC
Director, SmartScene Engineering

DAN P. MAPES
Lead Engineer, SmartScene

PAYTON WHITE
IVAN SCOTT FULLER
Technical Staff, SmartScene

BILL PRESKAR
Senior Database Modeler, SmartScene

KEN BETTS
Database Modeler, SmartScene

SPU-Darwin, Lego A/S

DENT-DE-LION DU MIDI
Director of Research and Development
Advanced Visual Computing Lab

JULIAN GOMEZ
Chief Scientist
Advanced Visual Computing Lab

BO NIELSEN
Software Designer
Advanced Visual Computing Lab

CLAUDE AEBERSOLD
3D Artist
Advanced Visual Computing Lab

Fakespace Labs

CHRISTIAN GRUEL

Contact
PAUL MLYNIEC

SmartScene Engineering
MultiGen Inc.
550 South Winchester Boulevard,
Suite 500
San Jose, California 95128 USA
+1.408.556.2633
+1.408.261.4101 fax
pmlyniec@multigen.com

In a full-immersion, stereoscopic VR presentation, over 350 beautiful species of butterflies from all over the world fly around you in a natural setting. At your command, they land for close examination and provide information about their species and origin.

Participants start from several hundred miles above the slowly rotating Earth. In the eventual application, they will be able to choose where they wish to go, and only butterflies that live in or migrate to that region will appear. For the Digital Bayou, butterflies will descend to Louisiana, and land in a countryside setting outside New Orleans.

Participants are surrounded by hundreds of flocking butterflies. In their hands, they hold a species of flower that butterflies are commonly attracted to. When they point it toward a butterfly and press the controller button, the butterfly lands on the flower. They can then bring the butterfly close for detailed examination. A voice in the headphones specifies the name of the butterfly, its species, its family, its native locale, its migratory habits, and its preferred diet.

Male butterflies are generally more colorful than females, so participants may choose males at first, but when the female is described, the butterfly morphs into its female form. It may also morph into related species to demonstrate the phenomenon of mimicry, or into a seasonal variation of its color patterns. The experience evokes the almost-universal primal memory of childhood, when a butterfly landed near or on us and awakened our sense of wonder at the fragile beauty of nature.

Contributors

BRETT WEICHERS

NORMAN PENNY
Head Curator, Academy of Science

Contact
CARLOS NEWCOMB

Blue Morpho Productions
S.S. Vallejo
Varda Landing
Sausalito, California 94965 USA
+1.415.332.5111
+1.415.331.3335 fax
morpho@warp.com

This interactive exhibit from the research labs of Philips Electronics demonstrates interactions between real users and autonomous agents in an immersive virtual entertainment experience. In a soccer game, teams of autonomous agents compete against each other and real users, who can participate as players, spectators, and even referees. A Reality Engine provides appropriate audio and other sensory information to enrich the experience.

Novel elements of *Virtual Playspace* include: an immersive virtual environment in which real people interact with autonomous agents, a demonstration of Philips' autonomous agents technology, and an opportunity to observe emergent behavior, as agents composed of relatively simple rules combine to produce complex systems.

Contributors

RICHARD GALLERY
DALE HERON
DAVID EVES
ZEENAT JETHA

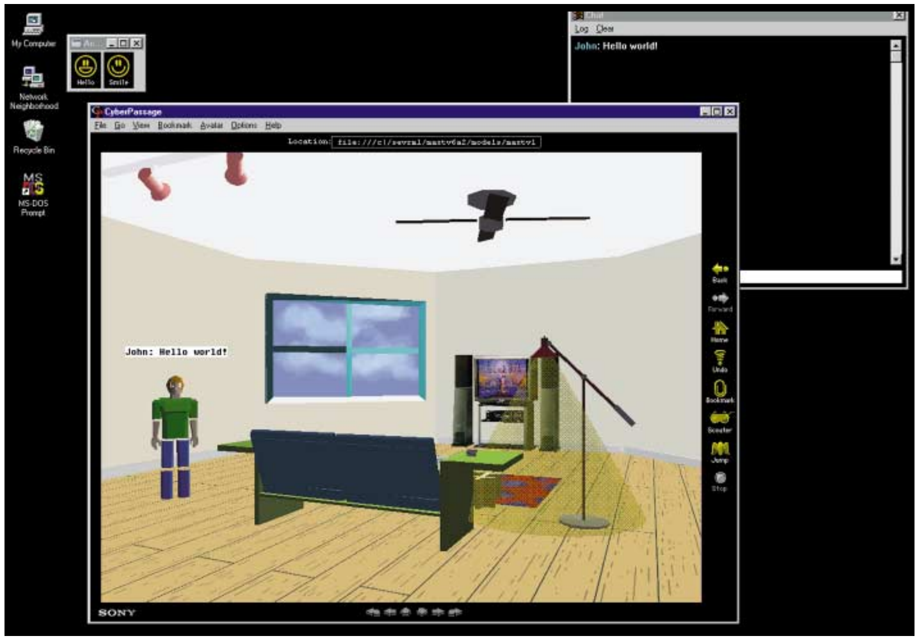
Contact
RICHARD GALLERY

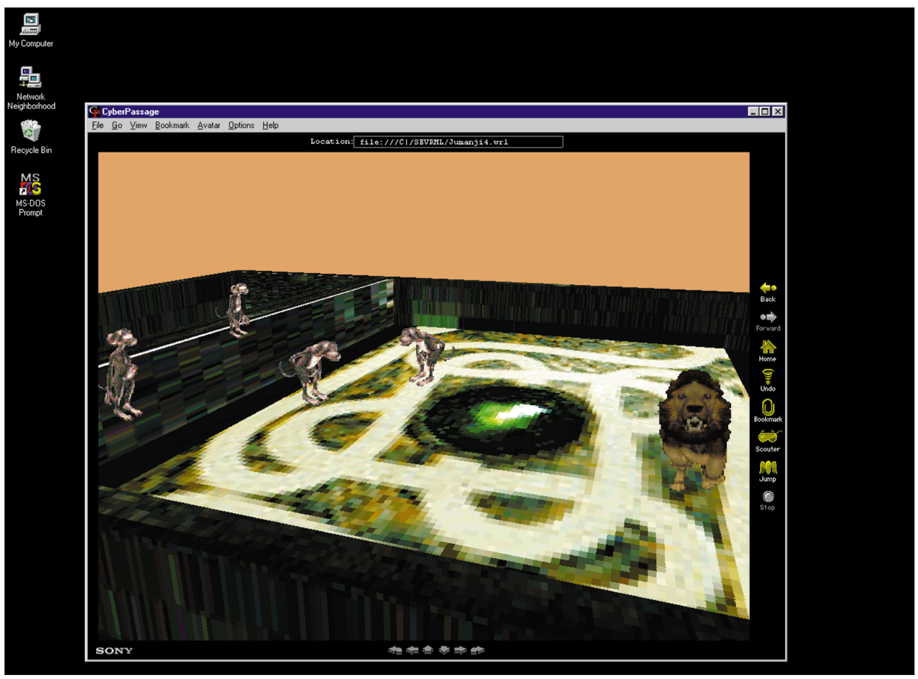
Philips Research Laboratories
Cross Oak Lane
Redhill, Surrey RH1 5HA
UNITED KINGDOM
+44.01293.815167
+44.01293.815500 fax
gallery@prl.philips.co.uk

Existing electronic media such as the telephone, radio, and TV, were developed with little or no integration, each independently establishing its presence via its consumer base, transmission capacity, and interactive capability. With the progress of digital technology in recent years, we are witnessing great changes in computing and communications. What used to be simple information-processing devices are now plugged into massive networks. As a result, our familiar computer and home electronics hardware is becoming a gateway to powerful new interactive experiences.

Virtual Society illustrates a new medium that exists across networked computers and enables simulation of real space in more intuitive forms. By incorporating a 3D presentation, this medium brings to life functions that would be impossible or cost-prohibitive in a real space/time axis. With CyberPassage Conductor, users create and edit the 3D informational world of their dreams.

As a step toward creating this *Virtual Society* within cyberspace, Sony presents a beta-version extension for VRML. The VRML browser enables users to wander in 3D space and manipulate moving images, movies, and sound. The society server, CyberPassage Bureau, provides a further multi-user dimension to the 3D space, allowing concurrent users to see representations of and chat directly with each other.





Contact
FRANK FOSTER
YOSH KAMBE

Sony Pictures Imageworks
Culver City, California USA
+1.310.280.7603
frank@spimageworks.com

In this interactive and immersive virtual 3D edition of a 2D computer game, a lone spacecraft encounters aggressive forces in a virtual galaxy complete with star clusters, dark matter, and simple relativistic effects. The participant uses a 3D mouse to navigate a high-speed craft through interstellar space toward an intergalactic space fortress. It is no easy task to reach this fortress target. The intervening space contains closely packed and tethered explosive mines deployed by hostile forces.

This navigational task places heavy demands on the situational awareness of the participant, who is continually challenged to track egocentric and geographic locations within the space. The participant is required to respond to localized 3D audio inquiries and manage virtual graphical controls.

Contributors

VICTOR BONILLA
Hughes Training, Inc.

KEITH NIALL
DCIEM

RICHARD THURMAN
Armstrong Lab

LARRY WALLACE
Division, Inc.

Contact
TRISH RUSSO & VICTOR BONILLA

Hughes Training, Inc.
6001 South Power Road
Building 560
Mesa, Arizona 85206 USA
+1.602.988.9773 x144
+1.602.988.9803 fax
russo@alhra.af.mil

Visualization of Earth and Space Science Data

Daily demonstrations of several interactive JPL systems for processing and visualization of science data returned by instruments flown on spacecraft in earth orbit and on solar system exploration missions:

1 **The Science Analysis Graphics Environment (SAGE)**
A graphical interface used to control processing of imaging and other science data returned by the Pathfinder solar system exploration mission in 1997, providing stereoscopic mission planning tools for supporting rover navigation on the surface of Mars.

2 **VISTAS**
An interactive tool for query and retrieval of earth-observation data acquired by the TOVS sensor.

3 A working prototype of software that will be used to process data returned by the Atmospheric Infra-Red Sounder (AIRS) to be flown as part of NASA's Mission to Planet Earth.

4 Animation and "fly-by" systems to explore Mars, Jupiter, and Venus.

5 Internet-accessible image database browsers and navigators that provide public access to space mission image archives.

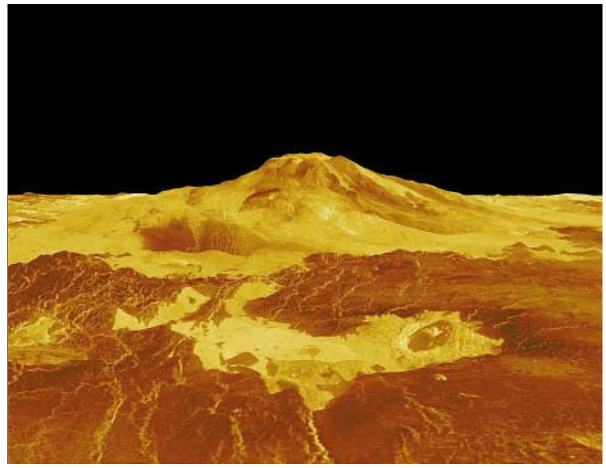
6 Other current work focusing on processing of operational data.

Contributors

PAUL ANDRES
PETER BLINN
KRIS CAPRARO
JERRY CLARK
ROBERT DEEN
DAVID FREDA
ZAREH GORJIAN
JEFF HALL
TOM HANDLEY
FRANK HARTMAN
DANIKA JENSEN
PAM WONCIK
BILL LINCOLN
DAVE KAGELS
MYCHE MCAULEY
BARBARA MCGUFFIE
MIKE MUELLER
STEVE NOLAND
VADIM PARIZHER
LARRY PREHEIM
KEN SCOTT
SHIGERU SUZUKI
CHARLES THOMPSON
JOHN WRIGHT
TOM THALLER

Contact
WILLIAM B. GREEN

Science Data Processing Systems Section - JPL
California Institute of Technology
4800 Oak Grove Drive
Mail Stop 168-527
Pasadena, California 91109 USA
+1.818.354.3031
+1.818.393.6962 fax
Bill_Green@iplmail.jpl.nasa.gov



wango:IW (Immortal Wire)

Wango: IW is a technology-based art installation that evolves through participant interaction. It explores the capabilities of signs, symbols, and languages to devise a model for communication in a networked, accessible VRML environment. Participants engage in direct, interior, aisle, and network exploration; help create signs and symbols by responding to associated imagery; and create visually networked spaces for interaction and communication. Interaction is based on HTML, VRML, and trigger-based installation devices.

By addressing the issue of universal communication and ownership, Team CADRE is collaboratively developing a code of signs and symbols to create a new means of communication based on individual perception.

Contributors

NAELLA AL-AQEEL
FRED ALDESHULTE
DEBORAH ALPERS
GABRIELLE BYE
CHRIS DEMETER
PAUL GOFBERG
PENNY HUM
CORRINE JEW
KAREN JOHNSON
BETH NU
JENBEL PHAN
KIT PRAVDA
SYLVIA ROHRL
SEAN SPITZER
TUAN TROUNG
CASSANDRA LEHMAN, ADVISOR

Contact
NAELLA AL-AQEEL

Team CADRE
The CADRE Institute
San Jose State University
One Washington Square
San Jose, California 95192-4399
USA
+1.408.924.4399
+1.408.998.1342 fax
naella@best.com

Immersive real-time simulations (virtual environments) are now common in entertainment, military, marketing, and industrial applications. This project illustrates how virtual environments are used for collaborative, international training of astronauts. It is supported by common application protocols for distributed virtual environments and ISDN and ATM technologies for intercontinental communications network links. The protocols were developed by the Fraunhofer Institute for Computer Graphics in collaboration with the University of Houston Virtual Environment Technology Laboratory.

In *Where No One Has Gone Before*, American astronaut Bernard Harris and German astronaut Ulf Merbold rehearse a normal maintenance job for two astronauts: replacement of the Hubble Space Telescope's solar array drive electronics. For the first time, astronauts far removed in physical space, one in Houston and the other in Darmstadt, perform complex tasks simultaneously in a virtual environment.

Virtual environments can also help engineers, scientists, and the public understand more down-to-earth systems such as the Volkswagen TDI (turbo direct-injection) Diesel Engine. In a second demonstration, *Where No One Has Gone Before* presents a virtual reality walk-through that immerses participants in downtown Frankfurt and then transports them through the heart of the Volkswagen engine. The virtual environment dramatically demonstrates the unique features of the new TDI engine. It enables interactive visualization of how the engine performs compared to a comparable gasoline engine, why it is cleaner than most gasoline engines, and why it provides much better fuel economy.

The engine model was extracted from CAD data using an extended version of Virtual Design II to enable steering of time-dependent scenes so that an operator can trigger single events as well as control the direction and speed of the presentation time.

This visualization demonstrates the efficient operation of the combustion process. It is based on a finite-element grid created by Volkswagen engineers during optimization of piston shape in flow simulations. The finite-element data included velocity, temperature, and pressure at each point. The flows were pre-processed so they could be represented in real-time. Injection of the diesel particles and ignition of the gases during combustion was also pre-calculated. Algorithms were developed to calculate the flow lines and particle traces that enable the user to interactively visualize the flow field of the turbulent gases in the TDI cylinder and exhaust.

This project demonstrates that virtual environments can take you to work in outer space on a Hubble training mission or into the inner workings of an advanced diesel engine, and allows you to share those experiences in the same room or across the globe via high-speed networks.

Contributors

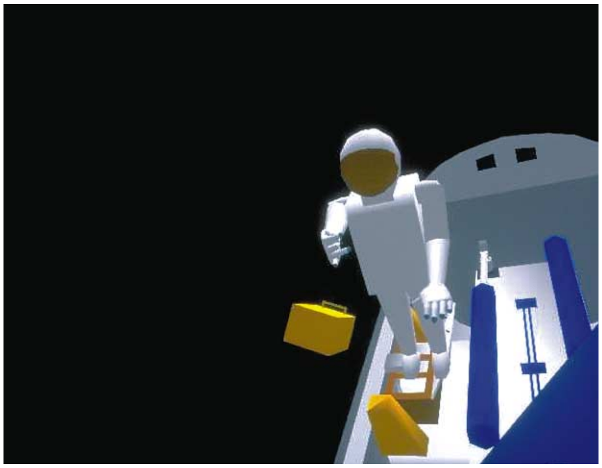
IGD
WOLFGANG FELGER
FAN DAI
TORSTEN FROHLICH
THOMAS FRUHAUF
STEFAN MULLER
DIRK REINERS
NORBERT SCHIFFNER
GABRIEL ZACHMANN
ROLF ZIEGLER

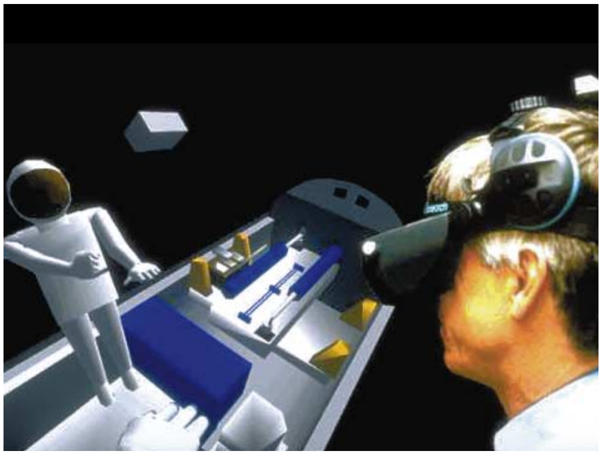
CRGG
AMMO GOETTSCH
HANS JOSEPH
EDWIN KLEMENT

University of Houston
R. BOWEN LOFTIN
PATRICK J. KENNEY
ROBIN BENEDETTI
CHRIS CULBERT
MARK ENGELBERG
ROBERT JONES
PAIGE LUCAS
MASON MENNINGER

Contact
MICHAEL R. MACEDONIA

Fraunhofer Center for Research in Computer Graphics
167 Angell Street
Providence, Rhode Island 02906
USA
+1.401.453.6363
+1.401.453.0444 fax
mmacedon@condor.crcg.edu





W*izard Island* is a multi-user virtual environment designed for the bandwidth, latency, and rendering constraints of home computers and the Internet. It features VRML rooms and avatars, audio chat, client-authored 2D or 3D avatars, multiple camera views of the virtual world, and URL-based browsing of *Wizard Island* servers worldwide.

Unlike many virtual worlds, in which the author of the world defines the set of avatars visitors must choose from, *Wizard Island* allows each visitor to embody their own custom avatar. Users build their representations from a 3D VRML file or a 2D bitmap, and use that avatar in whatever *Wizard Island* world they decide to visit. This self-expressive power comes from an underlying symmetry between the client and the server. The server provides the space or building, while the client provides the avatar within it.

In the audio domain, *Wizard Island* provides a push-to-talk, queued audio chat that allows several people to talk simultaneously despite the large latencies common on the Internet. Utterances from multiple simultaneous speakers are played in order of reception rather than being mixed. In addition, a text chat can be used to add text narration to the experience.

The grammar of film begs to be applied to multi-user virtual worlds. As a first step in this direction, *Wizard Island* provides camera control distinct from avatar control. At any time, users can switch from a first-person point of view to over-the-shoulder or room-relative points of view. The user can even choose to see the world through the eyes of another avatar.

Contributors

BRAD NEEDHAM
SCOTT B. LEWIS
MARK MCGINLEY
ANDREW RIELLY

Contact
BRAD NEEDHAM

Intel Corporation
Mail Stop JF2-64
2111 N.E. 25 Avenue
Hillsboro, Oregon 97124-6497 USA
+1.503.264.8911
Brad-Needham@ccm.jf.intel.com

An extension of the Digital Bayou exists only on the Web: one of the first of many cities to be recreated in VRML.

Virtual New Orleans is a 3D, VRML representation of downtown New Orleans. It includes several neighborhoods, including the Waterfront, the French Quarter and the Convention Center area. In *Virtual New Orleans*, you can walk (or fly, if you prefer) down actual New Orleans streets. As you pass your mouse over a building, its address and company name are displayed. Each building is hyper-linked to the occupant's Web site, if they have one. Some buildings lead to interior models of the building (try clicking on the convention center).

Virtual New Orleans' 3D geometry was created in AutoCad and 3D Studio. Base data came from a number of sources including city GIS mapping, high-altitude photography, and the USGS. In order to make models that transmit quickly over the Internet, polygons and texture maps were used sparingly. (*Virtual New Orleans* is under 5,000 polygons).

When the modeling is complete, the file is translated into a VRML format. From there, it is massaged and optimized by hand (with a generous dose of help from Intervista Software). Key buildings have photos of the actual building applied to them. The architectural photographer took pictures of the buildings, scanned the photos onto Kodak photo CDs, removed cars, trees, etc. in Photoshop, and then applied the photos to the computer model.

Contact
DAVID COLLEEN

Planet 9 Studios
2 Harrison Street, Suite 145
San Francisco, California 94105 USA
+1.415.247.7997
+1.415.543.7037 fax
dcolleen@planet9.com
http://www.planet9.com

Scott Kim has provided his unique typographic animations, to be projected on the large screens above the Digital Bayou.

Contact
SCOTT KIM

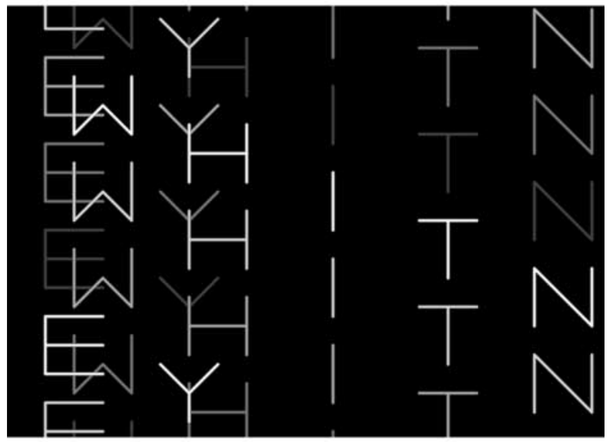
Scott Kim & Associates
4016 Farm Hill Boulevard #103
Redwood City, California 94061 USA
+1.415.328.6583
scottkim@aol.com

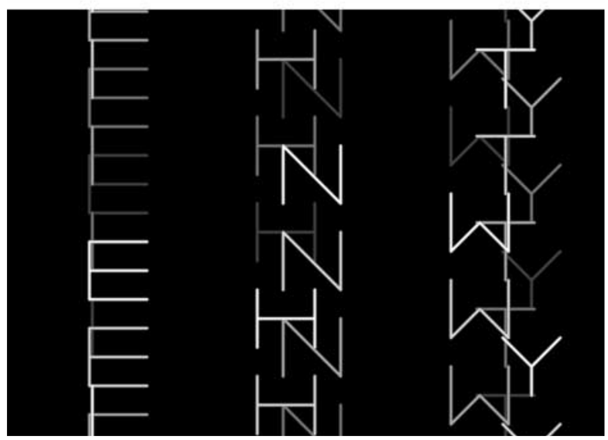
The written word sits on the edge between language and image. Illuminated manuscripts, record titles, and flying logos communicate their intent as much through visual style as through the literal meanings of the words. Groups like the Visible Language Workshop at MIT's Media Lab are exploring the visual possibilities of animated interactive typography.

"Flying Typography" is a series of animated interactive studies based on words and names from the world of computer graphics. Each word or name presents a surprising and appropriate formal relationship among the letter shapes that expresses the meaning of the word or the accomplishments of the person. For instance, the letters in "Whitney" mingle with each other in patterns similar to those in the films of John Whitney, Sr., while "analog" is written in continuous strokes so that when some of the pieces are removed the remaining discrete segments spell "digital."

"Input/Output" was created for a SIGGRAPH 85 exhibit of computer-produced art curated by Lucia Grossberger Morales. "Computer Graphics" was commissioned for a videodisk anthology of computer animation. "Turner Whitted" pays homage to the creator of ray tracing, a technique that makes reflections easy to render.

The SIGGRAPH 96 version of this work is limited to noninteractive animation. In the full version of the work, available on my web site, the viewer can control one or two parameters of each animation.





A solo sculpture exhibition contributes to the themeing of the Digital Bayou. It can be found along the main channels and in the backwaters.

Steve Storz is a professional artist based in California. Combining his training in electronics, theater, blacksmithing, and welding, he utilizes steel and technology cast-offs to construct what he calls STORZ Towers. These towers seem simultaneously ancient yet futuristic. Pieces of the past and present are fused to form structures of some unknown future. They are lit from within by LEDs, diffused behind circuit boards or slumped/fused glass, and give off a warm red, amber, or orange glow. Although they are made from a hard, cold medium, they appear delicately intricate and mysteriously filled with life. Enclosures made of cones and asymmetrical flats are inspired by the architecture of industry and nature.

Contact
STEVE STORZ

601 Van Ness Avenue #E3738
San Francisco, California 94102 USA
800.251.2968
STORZart@aol.com

Applications

Applications

Cross over The Bridge, drift down the Digital Bayou, and there you will find Applications. Like the ingredients of a savory Louisiana gumbo, this program holds a little something for everyone, for those with a budding curiosity but only minimal knowledge about computer graphics to the most experienced users and developers of computer graphics systems. Applications showcases effective use of computer graphics across a broad spectrum of disciplines including education, science, medicine, engineering, litigation, art, and entertainment. So enjoy your journey through the Applications images and explore the many facets of computer graphics.

To all those who contributed in one form or another, THANKS!

WARREN N. WAGGENSPACK, JR.
Applications Chair

Applications Committee

MICHAEL J. BAILEY
San Diego Supercomputer Center

MARC L. KESSLER
The University of Michigan Medical School

CHUCK HANSEN
Los Alamos National Laboratory

ALAN D. CHRISTIANSEN
Tulane University

BILL MALONE
Imagine Multimedia

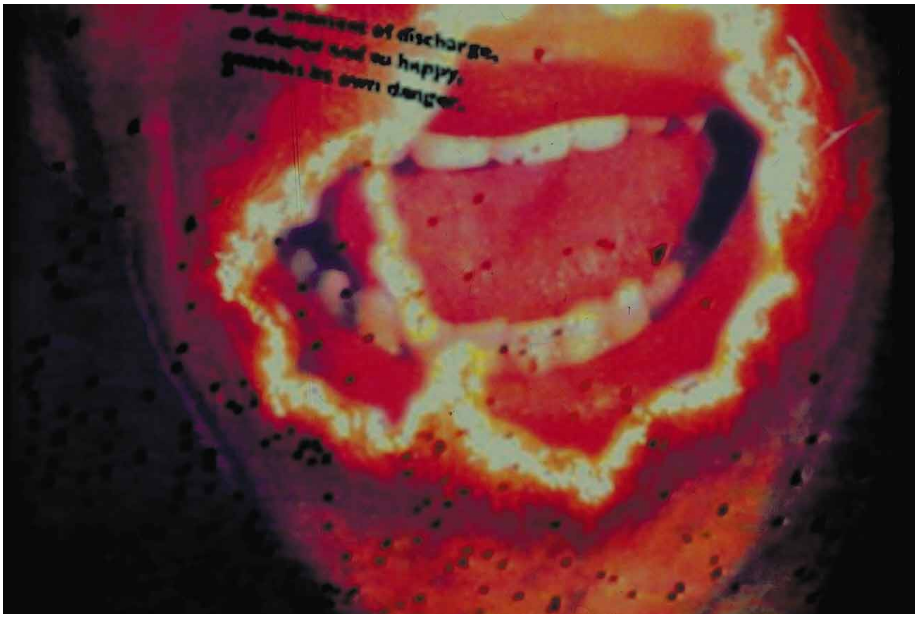
A Flock of Words: Real-Time Animation and Video Controlled by Algorithmic Music Analysis

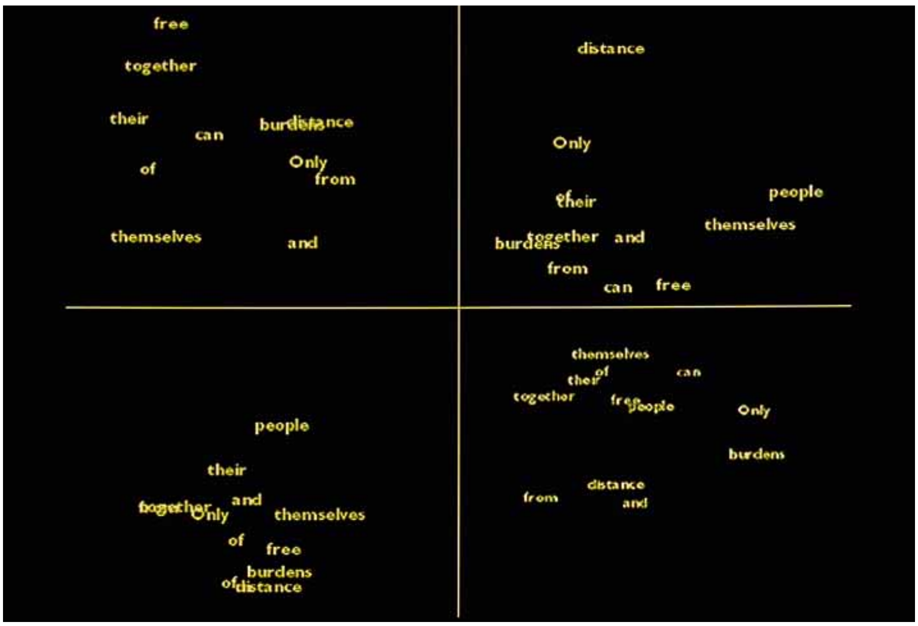
An interactive computer system combining large-scale holograms, video projection, animation, robotic lighting effects, and computer music was developed for composition of "Flock of Words," which premiered at New York University in the spring of 1995. The real-time animation, an adaptation of Craig Reynold's Boids algorithm, was used for animating text.

Contact

ROBERT ROWE
Department of Music
and Performing Arts Professions
New York University
35 West 4th Street, Room 777
New York, New York 10012 USA
+1.212.998.5435
rower@acf2.nyu.edu

DORIS VILA
Media Arts
445 Grand Street
Brooklyn, New York 11211 USA
+1.718.388.6533
vila@dorsai.org





AAPE: 3D Data Acquisition, Analysis, Presentation and Exchange

Contact
ROBERT J. FULL

Department of Integrative Biology
University of California, Berkeley
Berkeley, California 94720 USA
+1.510.642.9896
+1.510.643.6264 fax
rjfull@garnet.berkeley.edu

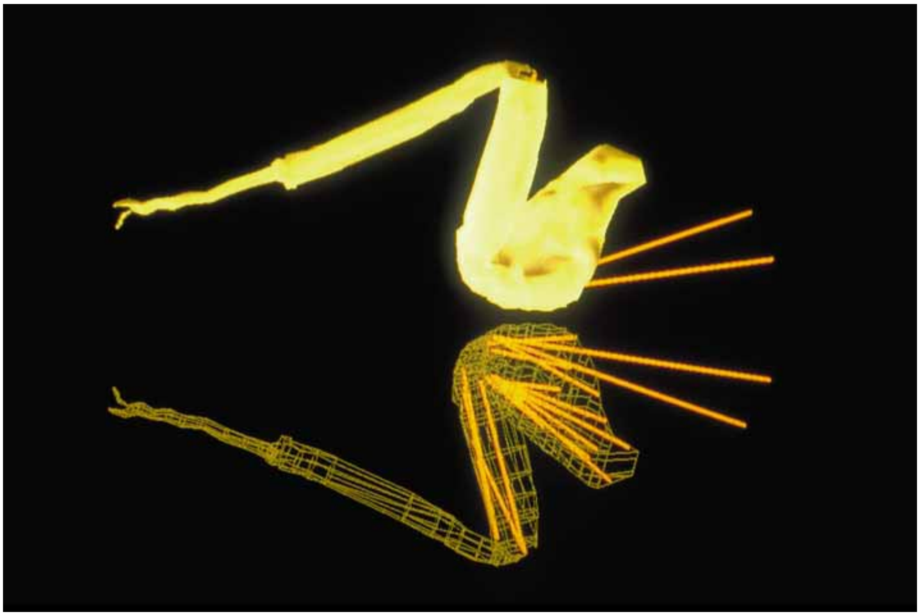
State-of-the-art instrumentation and computing power now permit organismal biologists to enter a new era of rapid, quantitative evaluation of organismal function at many scales and levels of organization, multiple species comparisons, multiple systems integration, and rapid, quantitative, dynamic behavioral analysis in 3D space facilitating dynamic modeling. We created a unique facility that will make 3D possible. Its three components are collectively termed the AAPE Facility:

A Data Acquisition

B Data Analysis/ Presentation

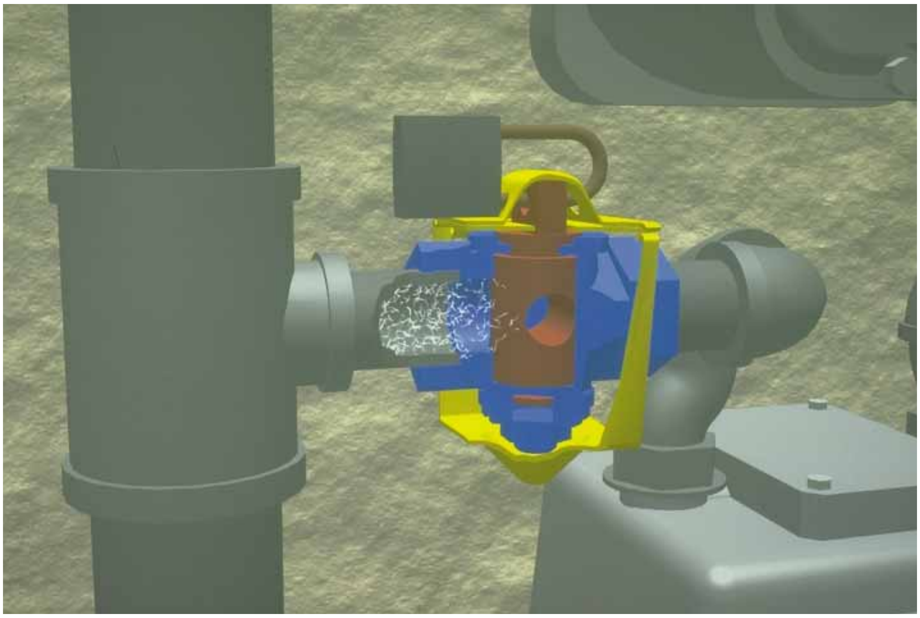
C Worldwide Data Exchange

We acquired six major, state-of-the-art pieces of equipment: a light and stereo-microscope, a 3D laser digitizer, a 3D high-speed imager, a 3D motion analysis system, a non-linear video editing system, and a graphics computer cluster to process, analyze and exchange the images and data. Projects greatly facilitated or made possible include: the neural basis for behavior, bio-mechanics of morphogensis, gut-chemical reactor modeling of digestion, 3D musculo-skeletal modeling of tetrapods to the earliest hominids, 3D dynamic whole-body modeling of insect locomotion, dinosaur behavior, and the fluid movements that affect organisms in the world's oceans. We demonstrate a project that illustrates the types of questions that scientists will be able to address using the facility: integrating the musculo-skeletal mechanics and locomotory control of animals (insects) using three-dimensional reconstruction and dynamic simulation.



SIMM software for interactive musculo-skeletal modeling. Musculographics, Inc.

In this description of the process used to produce animation and imaging for courtroom presentation, the animation process is reviewed from the discovery phase, story boarding, and 3D model building, to applying textures and scripting. The working relationships between attorney, expert witness, and animator are emphasized. Also reviewed: presentation of technical issues to a lay jury, the advantages of presenting scanned documents and photographs in a courtroom setting, the legal aspects of admittance of animation as demonstrative or factual evidence, and the equipment and methods of courtroom presentation.



Contact

DENNIS M. BREWER
Expert Computer Graphics Inc.
P.O. Box 9064
Mandeville, Louisiana 70470 USA
+1.504.674.2612
104124.1265@compuserve.com

CHARLTON B. OGDEN III
Monroe & Lemann, Law Offices
201 St. Charles Avenue, 33rd Floor
New Orleans, Louisiana 70170 USA
+1.504.544.7237

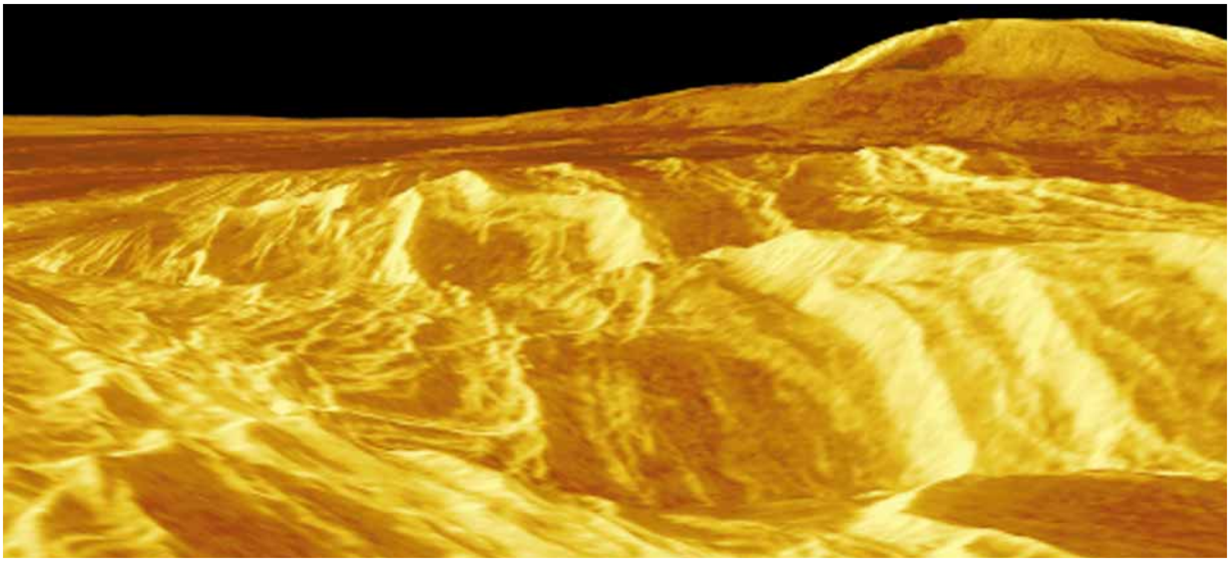
Animations from NASA's Exploration of Outer Space: Use of Computer Graphics with Satellite Data

The Jet Propulsion Laboratory's Visualization and Earth Science Applications group has worked for more than 10 years to produce dramatic pictures and animations of the planets and moons of our solar system.In the process, we have developed expertise in applying computer graphics tools and techniques to scientific data remotely sensed from spacecraft.Today, this type of data is available to the public in great profusion, and it is widely used in a variety of graphics-based applications.

This presentation includes various methods for displaying and animating remotely sensed data, putting the data into a context that is intuitive and useful to the viewer, and using computer graphics techniques to display data in a form that can convey more meaning, not only to the general public but also to the scientific community.

Contact

JEFF HALL
Jet Propulsion Laboratory
California Institue of Technology
4800 Oak Grove Drive, MS 168-414
Pasadena, California 91109 USA
+1.818.354.4249
Jeffrey.R.Hall@jpl.nasa.gov

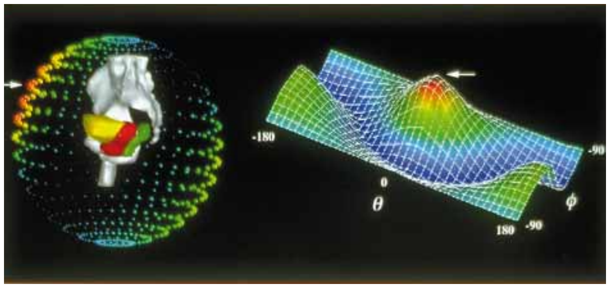


Clinical Application of Computer Graphics for Design and Delivery of Conformal Radiation Therapy

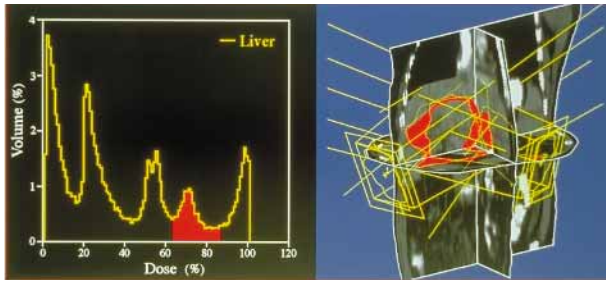
Radiation therapy, one of the most widely used forms of cancer treatment, affects the lives of over 600,000 patients annually. The challenge of planning radiotherapy treatments is to carefully tailor a radiation dose that will kill the tumor while avoiding as much healthy tissue as possible. Toward this end, investigators at the Department of Radiation Oncology at the University of Michigan have developed and applied visualization techniques that exploit 3D computer graphics and medical image data to help in the design and delivery of conformal radiation therapy treatments. By manipulating 3D computer models of the patient along with calculated dose information, the clinician can better appreciate the complex spatial relationships between tumor, normal anatomy, and beam trajectory. This understanding permits more precise determination of radiation beam arrangements, shapes, and strengths. These techniques are now being used in standard clinical practice to decrease normal tissue complications and increase cure rates from radiation.

Contact
MARC L. KESSLER

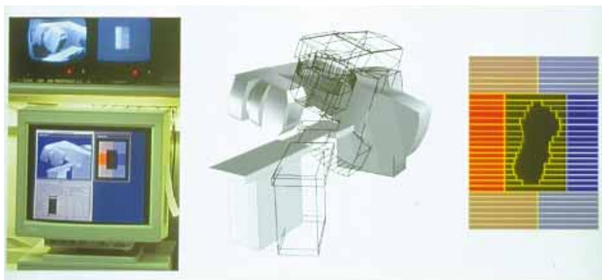
Department of Radiation Oncology
The University of Michigan Medical School
B2C490, Box 0010
1500 East Medical Center Drive
Ann Arbor, Michigan 48109 USA
+1.313.936.9342
+1.313.9365.7859 fax
mkessler@umich.edu

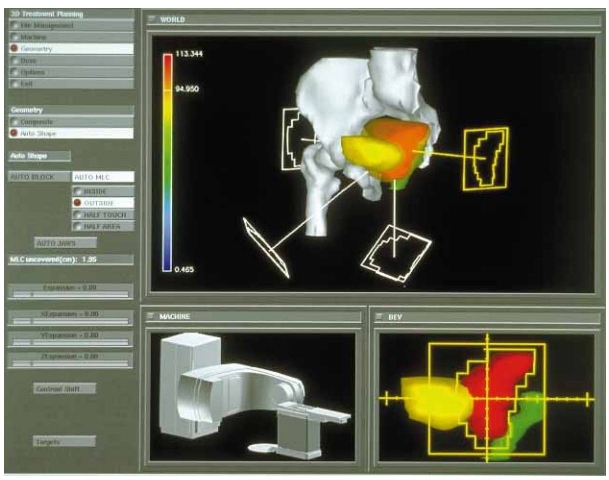


Beam placement visualization. Relative dose to a particular organ (bladder) computed for a set of beams and displayed together with the patient anatomy or as a colorized height mesh.



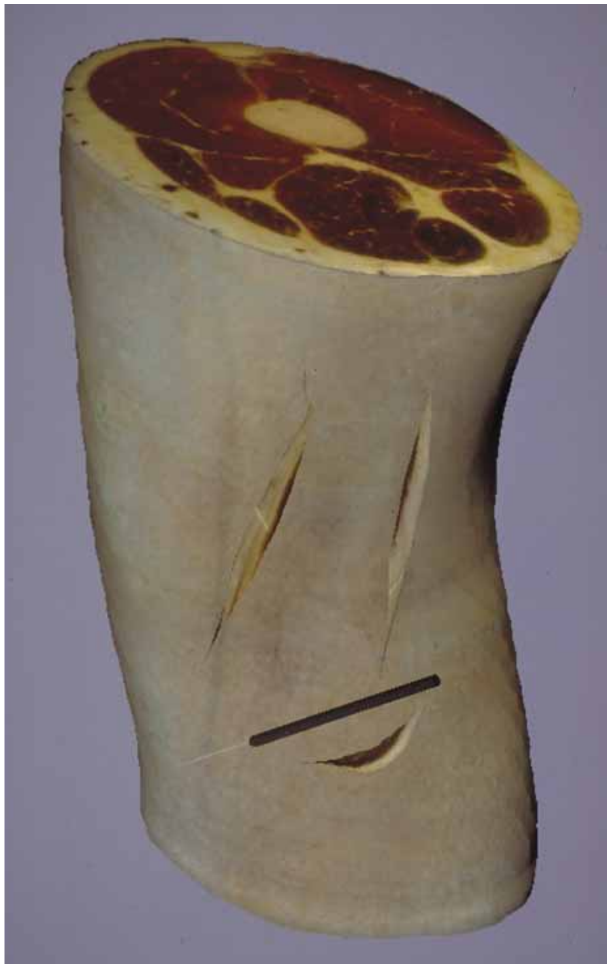
Dose analysis. Display of computed dose includes dose-volume frequency plots and a color washing of image data.


Treatment delivery verification. Graphical displays for treatment delivery verification include actual and simulated displays of the position and motions of the treatment machine.



Treatment planning user interface. Graphical user interface for radiation therapy planning showing models of patient anatomy, dose, radiation beams, and the treatment machine.

This talk discusses some of the current and more practical computer-based applications of the U.S. National Library of Medicine's Visible Human Dataset. These applications were developed at the University of Colorado Center for Human Simulation and the National Center for Atmospheric Research. The talk emphasizes applications that currently exist and presents a glimpse of what the future may hold.



Real-time surgical cuttings on the Visible Human Male's knee.

Operator feels the forces associated with inserting a needle to the Celiac Plexus of the Visible Human Male.

Contact

JOHN CLYNE
Scientific Computing Division
National Center for Atmospheric Research
1850 Table Mesa Drive
Boulder, Colorado 80303 USA
+1.303.497.1236
+1.303.497.1298 fax
clyne@ncar.ucar.edu

KARL REINIG
Center for Human Simulation
University of Colorado

This application is an inter-active catalog of visual information. It uses QuickTime VR to allow remote users to explore campus facilities from their homes and QuickTime video interviews to introduce users to faculty, staff, and students. It contains all the text information included in the traditional printed catalog, but it uses an unusual 3D-modeled interface to allow non-linear navigation of content.

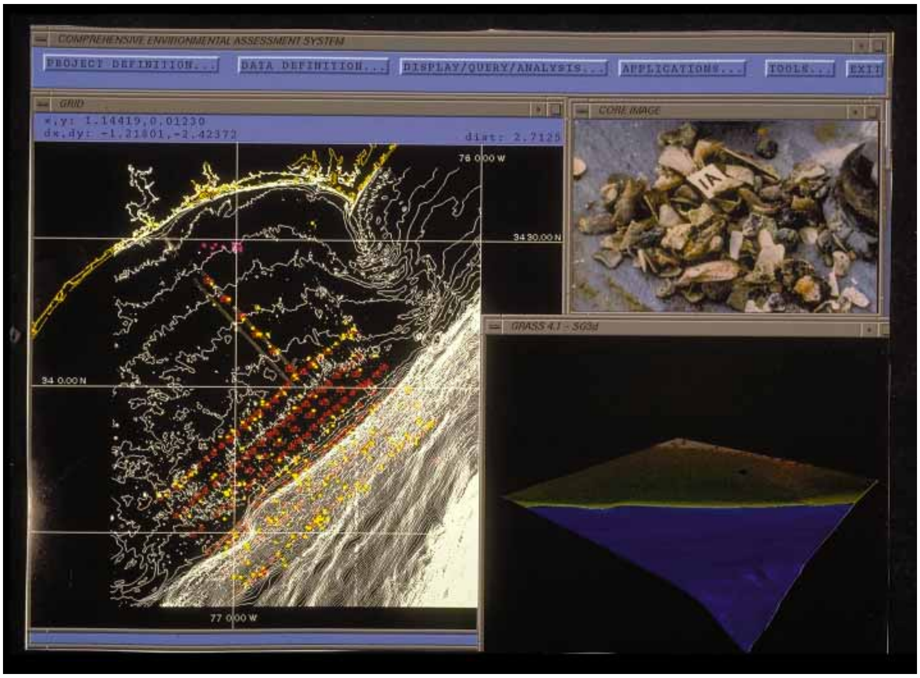
Contact
LUKE WANDER

Savannah College of Art & Design
201 West Charlton Street
Savannah, Georgia 31401 USA
+1.912.231.2313
luke@scad.edu

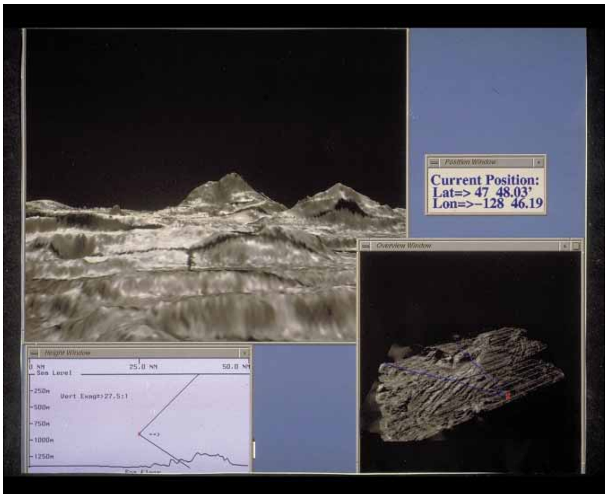
no slides yet

Data Visualization of Geophysical and Oceanographic Data at the Naval Oceanographic Office

Oceanographic data visualization at the Naval Oceanographic Office (NAVOCEANO) is accomplished using the Comprehensive Environmental Assessment System, an integration of GIS systems and in-house-developed tools used for analysis and visualization (2D and 3D) of geophysical and oceanographic data. This application uses the environmental data holdings of NAVOCEANO's Integrated Data Base Management System and other government agencies. 2D applications include visualization and analysis of bathymetry, bottom geology, acoustic bottom backscatter (imagery), gravity, altimetry, ocean profile parameters (e.g. salinity, temperature, and sound speed), and currents. 3D applications include integration of bathymetric (bottom topography), acoustic bottom backscatter for the rendering of bathymetry, Digital Elevation Models (DEMs, satellite imagery (SPOT and Landsat) for rendering of the DEMs, and vector data for generation of a seamless database used in developing animations for Naval applications.



Kenneth Grossman, Lockheed/Martin

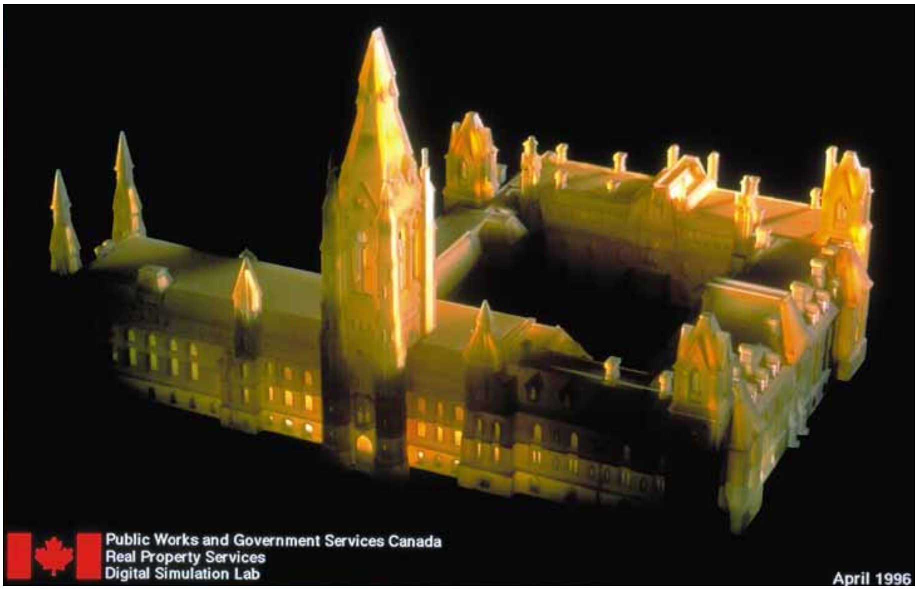


Dave Harvey, Naval Oceanographic Office

Contact
STEVEN LINGSCH

Naval Oceanographics Office
1002 Balch Boulevard / N533
Stennis Space Center,
Mississippi 39522-5001
+1.601.688.5313
lingsch@msrcnavo.navy.mil

Photo-realistic computer modeling techniques are currently being used by Public Works and Government Services of Canada to plan modifications to existing historical buildings in the Parliamentary Precinct in Ottawa. Using these advanced techniques, the Digital Simulation Laboratory, Real Property Services, can show exactly how changes will appear, plan alterations to the building, and record in an integrated manner all the architectural information pertaining to each building. With the help of the NRC-Institute for Information Technology, production of a physical model from the digital model using stereolithography technology was demonstrated.



Modeling and rendering of historical architectural sites usually require a high degree of geometrical details as well as a high level of photo-realism. The architectural 3D modeling process involves four main phases:

1. Information gathering
2. Modeling
3. Visualization and rendering
4. Architectural model generation

In this paper, we present a brief overview of each phase of the modeling process and demonstrate the results of this process on a real renovation project.

Contact

P. BOULANGER & G. GODIN National Research Council of Canada
Visual Information Technology Laboratory, Building M-50
Ottawa, Ontario K1A 0R6 CANADA
+1.613.993.1426 +1.613.952.0215 fax Boulanger@iit.nrc.ca

F. PELLETIER Digital Simulation Laboratory Real Property Services
Public Works & Government Services of Canada
Sir Charles Tupper Building Riverside Drive Ottawa, Ontario CANADA
+1.613.736.2263 +1.613.736.2826 fax pelletif@pwgsc.gc.ca

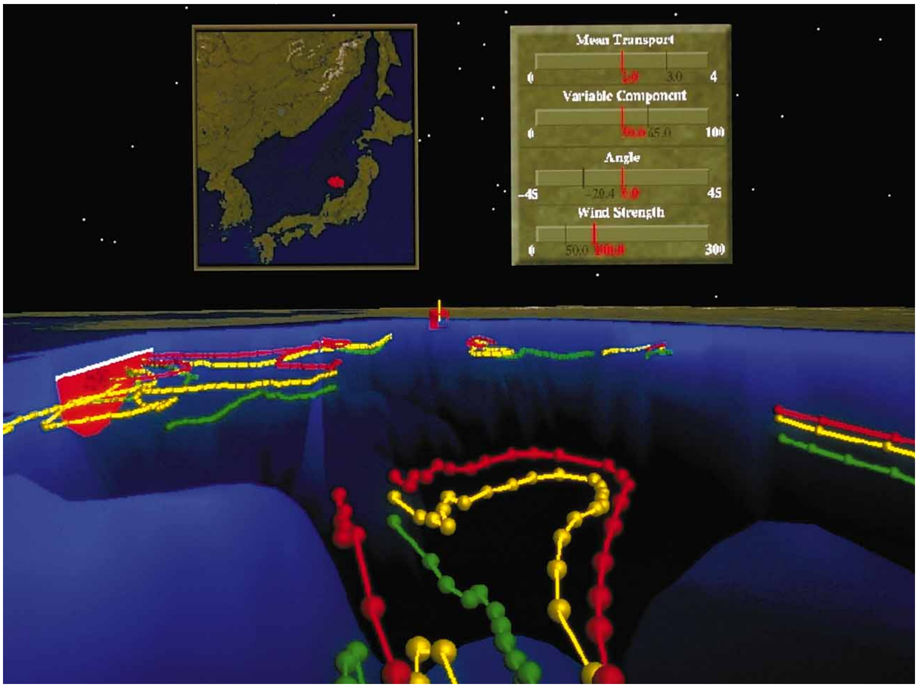
Computational resources, in-situ and satellite-based information about the oceans, and numerical models have dramatically improved in recent years. We are now on the threshold of a similar revolution in visualization technology, augmenting the static two-dimensional views of the past with four-dimensional immersive and interactive tools that can significantly address the challenge of understanding the dynamics of the oceans.

Examples of visualizations include 2D animations of El Niño propagation and the spreading of radionuclide pollution, as well as 3D animations of subsurface phenomena, including an interactive circulation model running on a remote supercomputer.

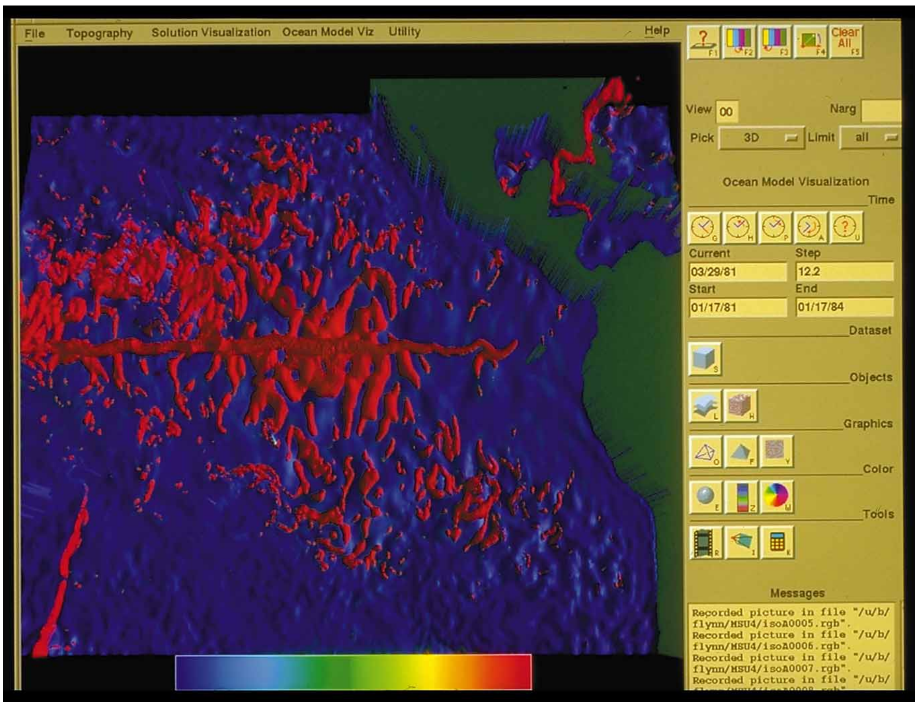
Additional information on this project is available at: http://www.erc.msstate.edu/thrusts/scivi/html/SC95.html

Contact
DANIEL N. FOX

Naval Research Lab
NRL Code 7323
Stennis Space Center, Mississippi
39529 USA
+1.601.688.5588
fox@nrlssc.navy.mil



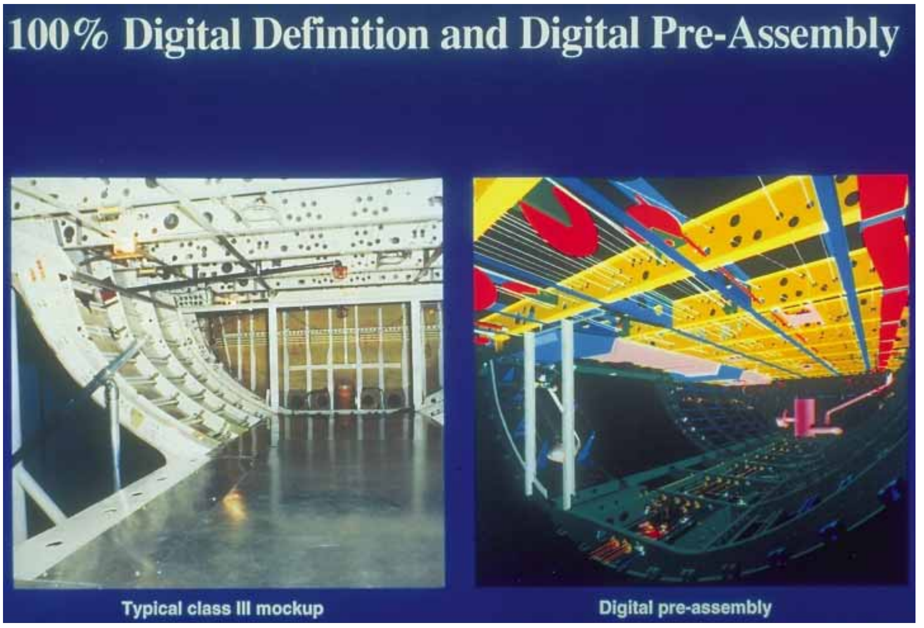
Naval Research Lab



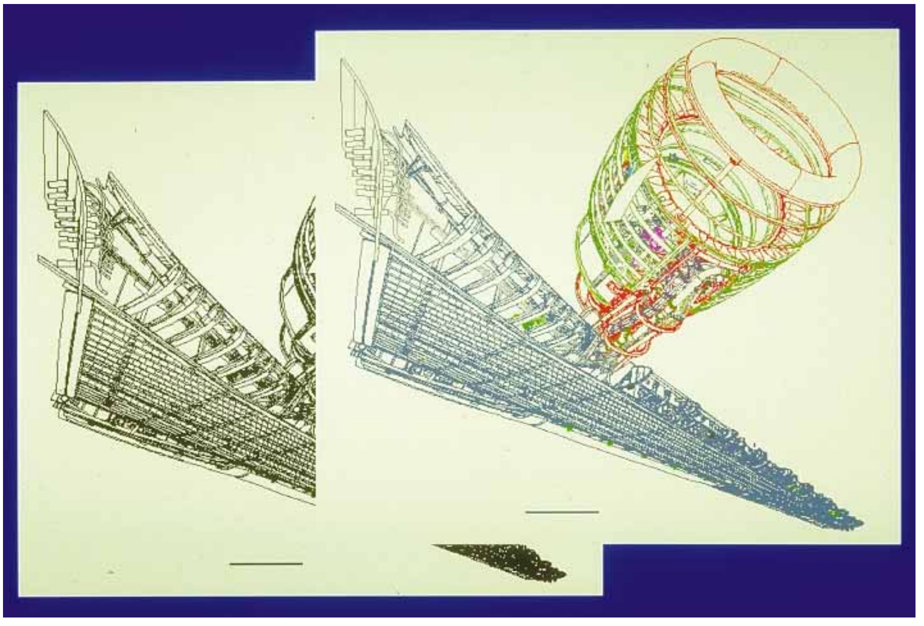
Engineering Research Center, Mississippi State University

In the late 1980s, The Boeing Company committed to build the 777, a twin-engine, wide-body passenger jet. The forward-thinking leaders at Boeing chose to design that airplane without the traditional class 3 physical mockups that made the design, planning, and manufacturing so expensive. They chose, instead, to use 100-percent electronic mockup with the computer-aided design (CAD) being done on Dassault Systemes' CATIA product.

An in-house application, FlyThru, was created by the authors in what was then called Boeing Computer Services to meet the need for greater analysis context. Because the 777 program must continuously examine whole large sections of the planned design, FlyThru has been consistently improved to keep pace with the ever-increasing need for graphics performance. FlyThru is now deployed widely at Boeing on almost every commercial airplane and defense project. It includes a system for distributing CAD data and for finding data of interest to groups of users, which has been used as a data warehouse infrastructure for FlyThru.



The Boeing Company


Microsoft Corporation

Contact

BOB ABARBANEL
WILLIAM MCNEELY
Advanced Design Systems
Research & Technology, Boeing
Information & Support Services
PO Box 3707, MS 7L-40
Seattle, Washington 98124 USA
+1.206.865.2734
+1.206.865.2965 fax
abar@boeing.com

ERIC BRECHNER
Microsoft Corporation

FreeWalk is a desktop meeting environment that supports informal communication generated by accidental encounters in a 3D virtual passageway. Users are represented on via live video, which allows them to move freely. They can watch others from a distance. Conversations can be started from chance meetings. And many users can talk simultaneously without confusion, just as they would in real life. Voice volumes are proportional to the distance between the sender and the recipient.

The prototype system has been used by six simultaneous participants, who have reported a variety of interesting behaviors, including eavesdropping on a couple's conversation from a distance.

Hideyuki Nakanishi
Chikara Yoshida
Toshikazu Nishimura

Contact
TORU ISHIDA

Department of Information Science
Kyoto University
Kyoto, 606-01, JAPAN
+81.75.753.4821
+81.75.753.4820 fax
ishida@kuis.kyoto-u.ac.jp

IF ALL THE WORLD'S A STAGE: The Impact of Global Illumination on the Entertainment and Architectural Lighting Art.

This presentation demonstrates the practical benefits of integrating still and interactive photo-accurate images into the entertainment and architectural lighting design process. In the hands of a theatrically trained lighting designer, the impact of software, such as RADIANCE, is having a profound influence on design methods and collaborative traditions. This session emphasizes how photo-accurate computer applications enables designers to develop their art with the assurance that the design will have the appropriate aesthetic and engineering consequences. Following a slide and video presentation, an application is demonstrated that will build a lighting storyboard for a hypothetical interactive design meeting.

The impact of these tools on the teaching of lighting design in a university situation is also demonstrated. The presentation concludes with a discussion of some innovative methods of developing the design and controlling the technology of theatrical lighting design through a graphical image interface.

Contact
ROBERT SHAKESPEARE

Theater Computer Visualization Center
Indiana University
400 East Seventh Street
Bloomington, Indiana 47401 USA
+1.812.855.8827
tcvc@indiana.edu

Closeup of rock and roll Moving Lights sequence

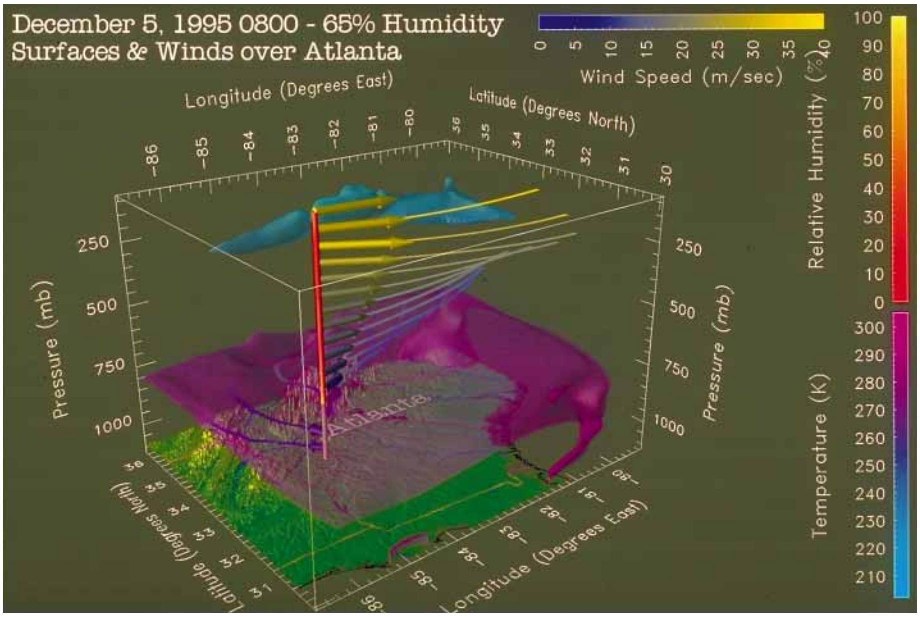
Long shot of rock and roll Moving Lights sequence

Interactive Visualization for Operational High-Resolution Weather Forecasting at the 1996 Centennial Olympic Games

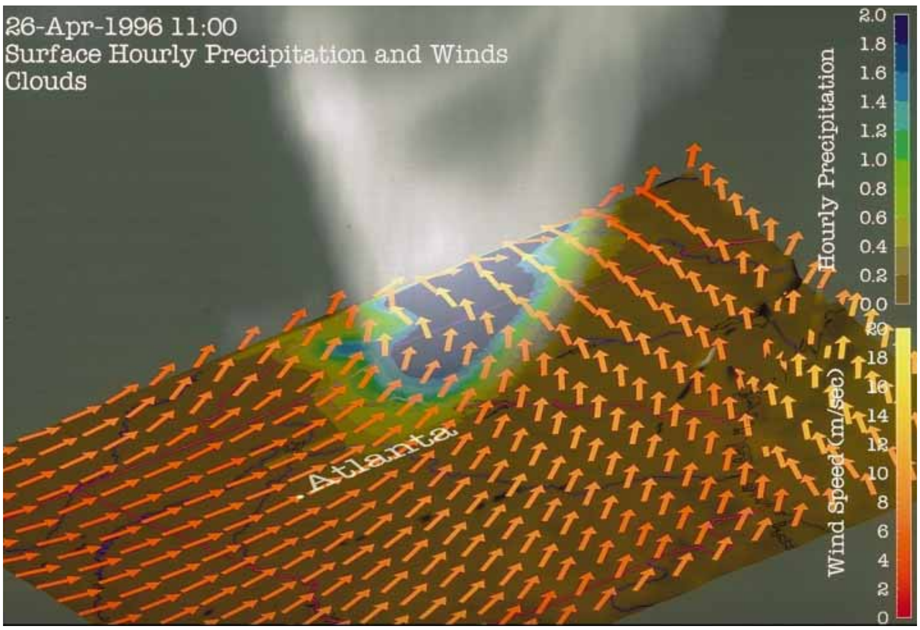
To improve the precision of weather forecasting at the 1996 Centennial Olympic Games, the National Weather Service, in a joint effort with IBM and others, utilized a high-resolution regional weather satellite over four main Olympic venues. This model focuses on cloud physics, permitting a more detailed prediction of precipitation. For more effective and timely analysis, two visualization strategies are employed. They were developed within a "natural" coordinate system to provide a context for three-dimensional analysis, viewing, and interaction. They provide representations of the state of the atmosphere registered with relevant terrain and political boundary maps. The first class is composed of simplified qualitative techniques to serve as browse products for gross assessment of model runs and source material for public dissemination (e.g., media, World-Wide-Web, etc.). The second class consists of quantitative techniques to support analysis and model interaction and interrogation.

Contact
LLOYD A. TREINISH
ZAPHIRIS D. CHRISTIDIS

IBM T.J. Watson Research Center
P.O. Box 704
Yorktown, Heights, New York
10598 USA
+1.914.784.5038
+1.914.784.5130 fax
lloydt@watson.ibm.com



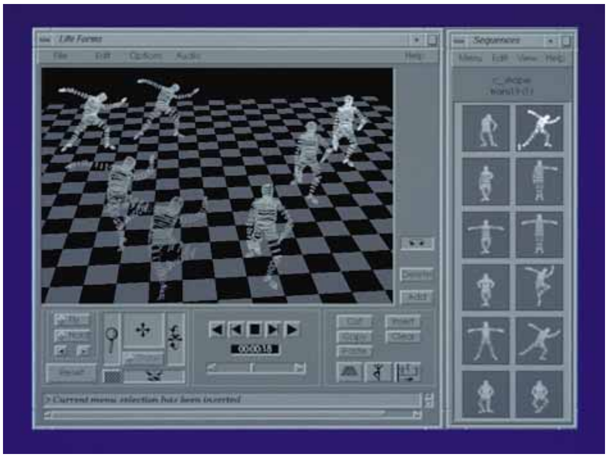
Volume rendering of cloud structure and correlation with surface conditions during heavy rainfall.



Virtual sounding of a modelled atmosphere showing local winds correlated with humidity and temperature.

Life Forms: An Application of Computer Graphics to Support Dance Choreography

The evolution of the Life Forms animation program is an application of computer graphics techniques to dance choreography, which feed back into development of new technologies. Choreographers are animators who work with live human figures. A dance is composed and choreographed by working out the movement phrases for each figure and directing the interaction between the figures. Life Forms, designed by a multi-disciplinary team of choreographers and computer scientists, provides a powerful intuitive interface to support these creative activities. The program is being used by choreographers around the world, including Merce Cunningham in New York. This presentation describes the Life Forms software tool with a focus on how choreographers are using it for visualizing conceptual ideas for movement composition before applying them to studio work.



Contact

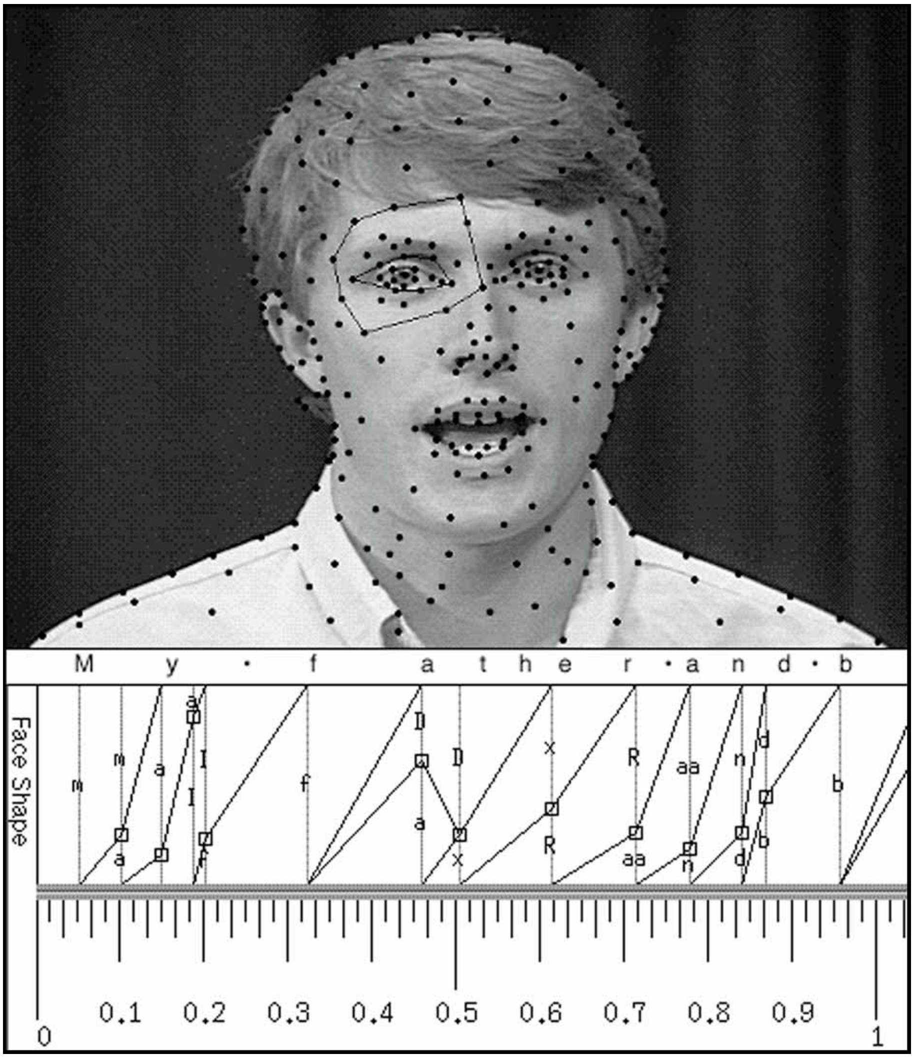
TOM CALVERT AND SANG MAH

Graphics and Multimedia Research Laboratory
Simon Fraser University
Burnaby, British Columbia V5A 1S6
CANADA
+1.604.291.4369
+1.604.291.4424 fax
tom@cs.sfu.ca
sang@cs.sfu.ca

MaxHeadRoom of the 21st Century: Producing Realistic Talking Head Animations Using the Actors System

Modeling and animation of realistic human figures remains a Holy Grail of computer graphics. JPL's Actors system embodies technology developed to swiftly produce startlingly realistic animations of a person speaking. Traditional manual techniques for animating computer graphics are rapidly being replaced by systems such as Actors that automate and simplify the animation process. A number of short animations created with the Actors system will be shown during the presentation

Actors combines a sophisticated morphing algorithm with a high-level, speech-based model for describing animation sequences. The speech model describes the transitions between phonemes and their relationship to the corresponding face "shape." A database of face shapes contains a picture of a face in the act of producing the sound and a set of tiepoints that identify facial features. The basic morphing algorithm has been extended to provide for perspective transformations of the face (simulating head rotations), multiple-layers to allow independent control of features (head, eyes, etc.), and piece-wise linear inter-frame interpolation.

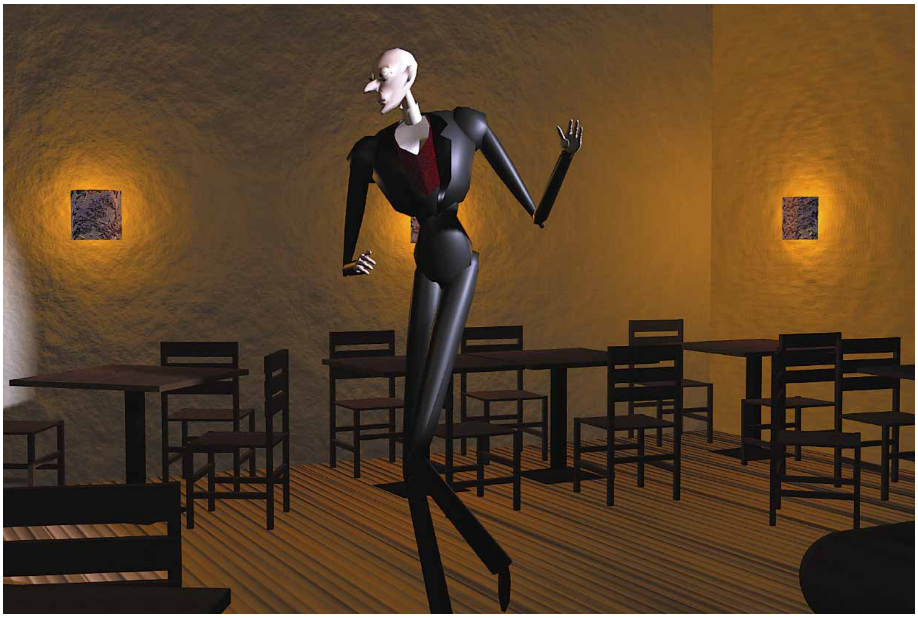


Contact
KENNETH C. SCOTT

Jet Propulsion Laboratory
California Institue of Technology
4800 Oak Grove Drive MS 168-414
Pasadena, California 91109 USA
+1.818.354.8482
+1.818.393.6962
Ken.Scott@jpl.nasa.gov

Improv, a system for improvisational computer animation, has been extended to incorporate dancing, music, speech, background sound, and user control from external input devices. Virtual actors in Improv are autonomous, directable animated characters that choose actions in reaction to their environment based on scriptable personality traits. New features include a dance designer, enabling the user to design dance steps for the actors; a virtual band, with musicians modeled as audio actors; a speech component, enabling actors to select and speak pre-recorded phrases; controllable, ambient background sound; and external control from input devices such as electronic musical instruments.

Employing the new capabilities, we describe a demonstration in which the virtual band is conducted by a person playing an electronic drum while a virtual actor "listens" and dances along, altering his dance style based on attributes of the music. We also discuss use of the new Improv system as featured in our interactive installation in the Digital Bayou at SIGGRAPH 96.

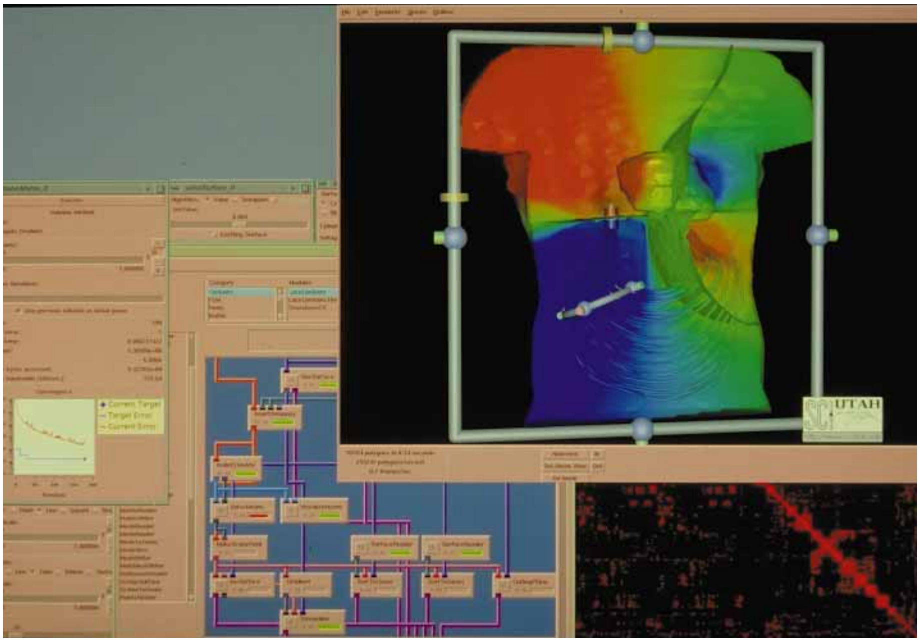


Contact
ERIC L. SINGER

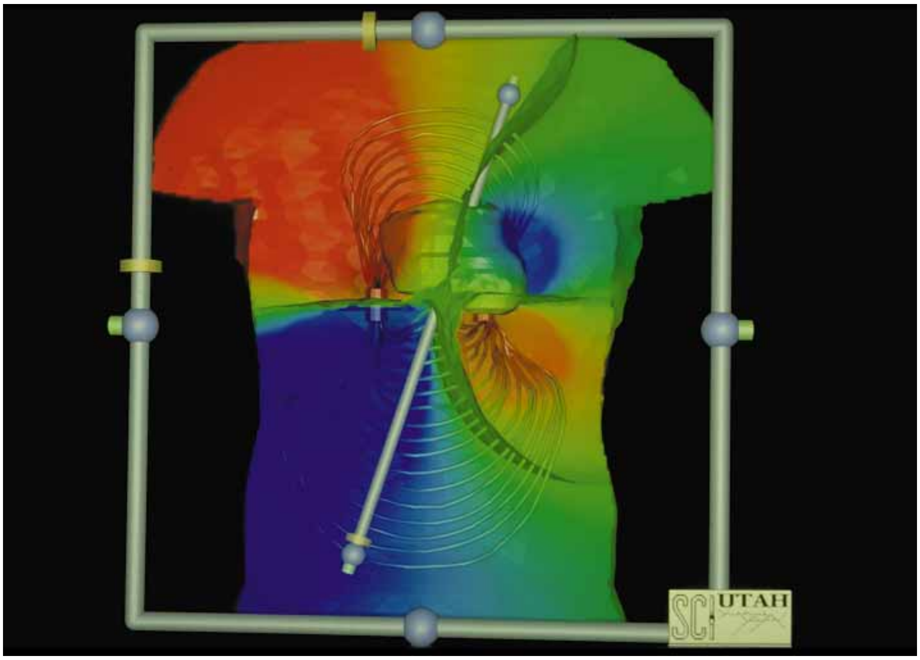
Media Research Lab
New York University
719 Broadway
New York, New York 10003
+1.212.998.3462
+1.212.998.4122
esinger@graphics.nyu.edu

In this demonstration, we show how several different digital technologies are used within SCIRun, a computational programming and steering environment. We explore how graphical user interfaces, high-performance graphics hardware, 3D interaction, scientific visualization, and advanced rendering methods are applied to problems in computational medicine and computational fluid dynamics. We demonstrate how the foundations of at least 14 SIGGRAPH papers over the past 13 years have contributed to the individual applications and how these applications have been integrated into a single interactive, visualization-based application for solving problems in computational science and engineering.

SCIRun is a framework in which large-scale computer simulations can be composed, executed, and interactively steered. Simulations are performed with a modular data flow system by specifying parameters with a graphical user interface. Steering a simulation involves making changes to simulation parameters as the program executes.



Steven G. Parker and Christopher R. Johnson



Steven G. Parker and Christopher R. Johnson

Contact
STEVEN G. PARKER
CHRISTOPHER R. JOHNSON

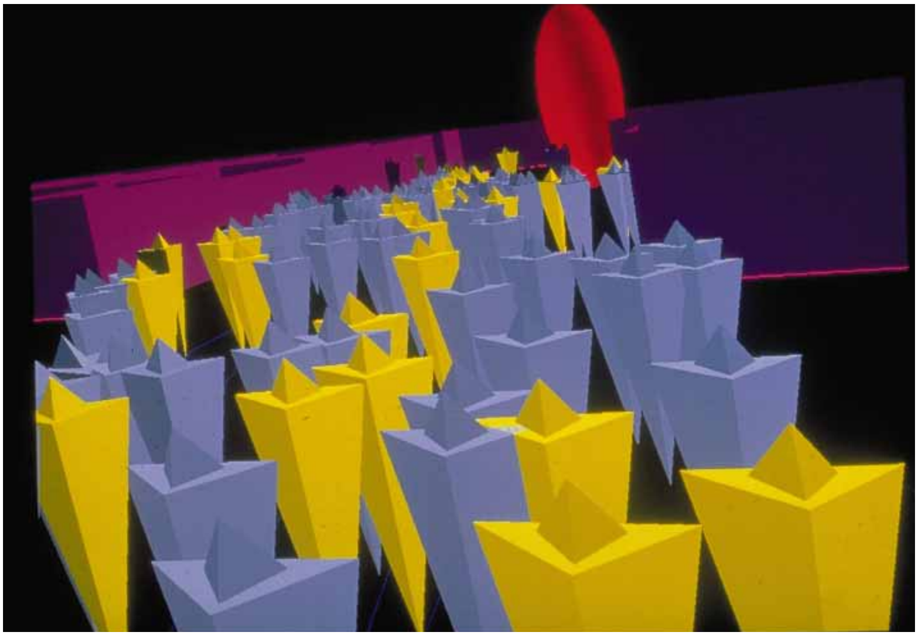
Department of Computer Science
3190 MEB
University of Utah
Salt Lake City, Utah 84112 USA
+1.801.581.8224
+1.801.581.5843 fax
sparker@cs.utah.edu

We present an application of computer graphics that has been designed by ArSciMed to provide new tools for design and security of public spaces. We have developed a crowd simulation software that can compute the movement of tens of thousands of individuals interacting in real time. The simulator has been used to model the traffic of pedestrians in the Stade de France, an 80,000-seat stadium under construction near Paris for the next World Cup. The simulator runs on a 16-processor IBM SP2 and updates in real time a 3D database that is interpreted as a virtual environment by a high-performance graphics workstation.

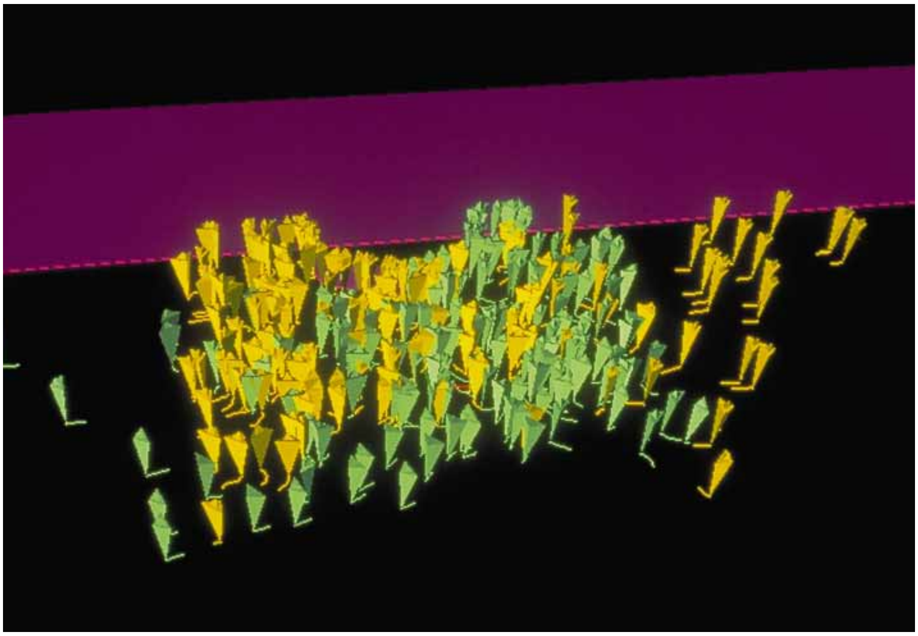
The presentation describes the application and explains how we model crowd behavior in both normal and emergency situations. We also present the various application fields of KINEMA/WAY, our commercial software based on the same technology.

Contact
JOSEPH PLONSKI

ArSciMed, Inc.
810 Memorial Drive
Cambridge, Massachusetts
02139 USA
+1.617.965.1674
+1.617.965.0286 fax
asm_us@ix.netcom.com



Crowd in front of an information booth in a hall.



Evacuation of a supermarket during a fire (symbolized here by the red light).

T2-3D is a new theme park attraction show for Universal Studios in Florida. The show is a multimedia event composed of live actors, physical stage elements, and three 50-foot wraparound screens displaying a completely rendered 3D world. The audience wears 3D stereoscopic glasses for an awesome virtual experience.

T-1,000,000 Creature

CG Supervisor
NEVILLE SPITERI

Animation Director
DANIEL ROBICHAUD

Digital Artists
CHRIS WALSH
GREGORY ECKLUND
JOSHUA KOLDEN
DAN LEMMON

T-1,000,000 Explosion

Lead Animator
AARON PFAU

Digital Artists
SCOTT STOKDYK
CURTIS EDWARDS
DANIEL LOEB
ZSOLT KRAJCSIK
MICHAEL HOBBS
MARK LASOFF
LAURA DIBIAGIO

SKYNET Background

CG Supervisor
JUDITH CROW

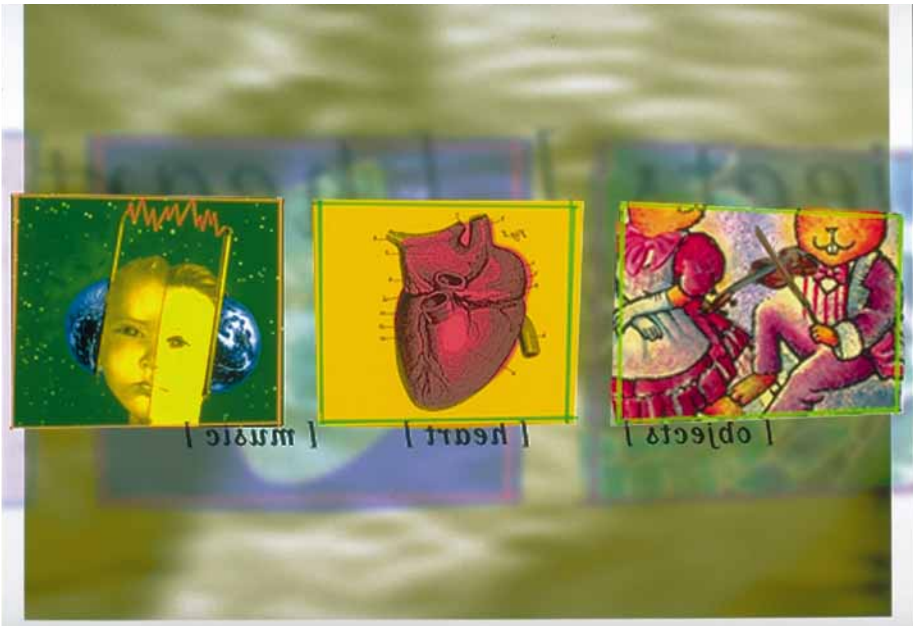
Compositing Supervisor
MARK FORKER

Digital Artists
PETER BAUSTAEDTER
FELICIANO DI GIORGIO
RICHARD KIDD
MARTINE TOMCZYK
XRAIG HALPERIN
CLUNIE HOLT
NIKOS KALAITZIDIS
ETHAN ORMSBY
BILL SPITZAK
JAMMIE FRIDAY
BRYAN GRILL

Contact
AARON PFAU

Digital Domain
300 Rose Avenue
Venice, California 90291 USA
+1.310.314.2853
+1.310.314.2888 fax
puffer@d2.com

The Remembering, an enhanced music CD that combines high-resolution sound with interactive 2D and 3D graphics, uses music, story, images, and interactivity to take the viewer back into the archetypal memories of childhood. The story and activities are designed for parents and children to experience together. The music stands alone as a regular "red book" audio CD, or it can be used in conjunction with text, images, and video on a PC. An online link to the Internet allow families to discover other information about the company and its artists, and link to other Web sites for families and children.



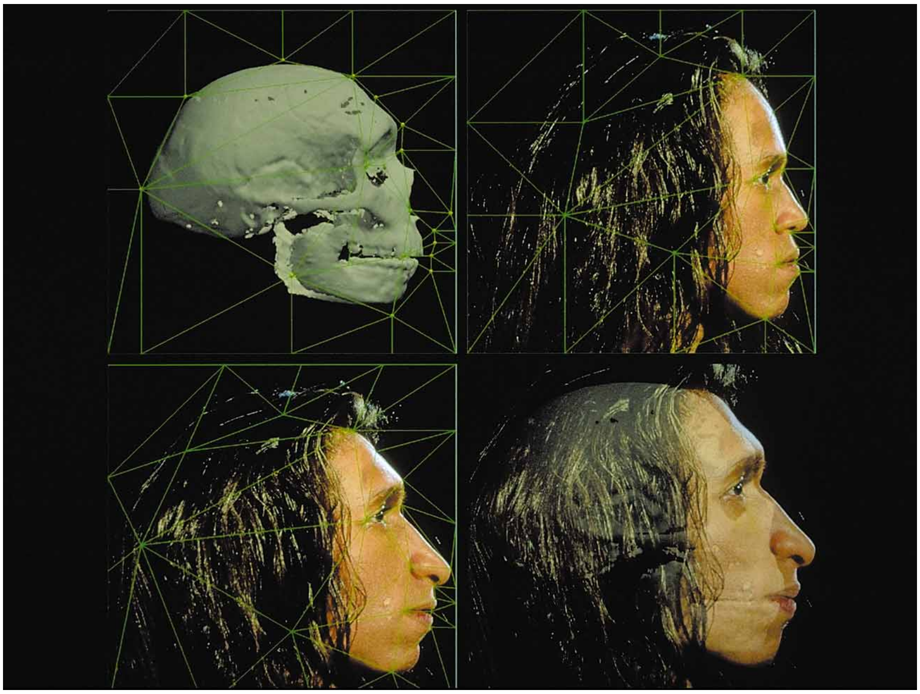
The Remembering/the store section, Watercolor and collage art by Aletha Reppel, Design by teamSmartypants

The Remembering/the music section, Watercolor art by Aletha Reppel, Photography by David MacKenzie, Design by teamSmartypants

Contact
JAN BOZARTH

Blue Arrow Words, Music & Images
14224 Hunters Pass
Austin, Texas 78734 USA
+1.512.266.7440
+1.512.266.7449 fax
jbozarth@bluearrow.com

For its January 1996 cover story on Neandertals, National Geographic Magazine sought the Biomedical Visualization Laboratory's (BVL) help in creating a series of new, photorealistic images of a Neandertal "family." BVL was asked to manipulate a staged photograph of costumed models prepared by National Geographic photographer Kenneth Garrett. The photograph, of a man, woman, and child, was provided to BVL along with three-dimensional digital data of Neandertal skulls, matched for sex and age with the corresponding models in the family portrait. The resulting images maintain the individualistic qualities of the posed portraits, but the facial proportions have been altered in a way that reflects the facial proportions of Neandertal skulls.



P. Neumann, L. Sadler, UIC Biomedical Visualization Laboratory. C. Sloan, K. Garrett, National Geographic Society.

Contact
PAUL F. NEUMANN

Biomedical Visualization Laboratory
1919 West Taylor Street, Room 213
AHPB M/C 527
Chicago, Illinois 60612 USA
+1.312.413.3092
pneumann@uic.edu

Visualization of Earth and Space Science Data at JPL's Science Data Processing Section

JPL's Science Data Processing Section is responsible for processing and visualization of remotely sensed imagery acquired by earth observations and planetary exploration spacecraft. This presentation provides an overview of systems currently used to process, manipulate, and display a variety of data. Examples include:

1 Graphical and visualization techniques used to query and retrieve data from large scientific data bases.

2 Graphical user interfaces used to control interactive and production processing of image data files.

3 Rendered animation sequences depicting planetary "flyovers."

4 Data returned by the Galileo spacecraft from the Ganymede encounter in June 1996.

5 Examples of image displays to be utilized to support operations of the Mars Pathfinder lander and rover spacecraft in 1997.

6 Examples of Internet interfaces developed to support public access to planetary image archives.

7 Examples of systems being developed to support earth remote sensing applications in the late 1990s.

Most of these systems are displayed in the SIGGRAPH 96 Digital Bayou.

Contact
WILLIAM B. GREEN

Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive,
Mailstop 168-527
Pasadena, California 91109 USA
+1.818.354.3031
Bill_Green@iplmail.jpl.nasa.gov

Sketches

Animator Sketches

Artist/Designer Sketches

Technical Sketches

Sketches

Welcome to the SIGGRAPH 96 Sketches.

Sketches are the forum where we air preliminary ideas, elucidate non-obvious aspects of our artistic works, and present modest but interesting and useful technical results. They are intended to provide something for everyone interested in the multifarious intellectual content of the SIGGRAPH conference. Because they are the repository of results that are too late-breaking or too eccentric to make it into the more traditional SIGGRAPH programs, they represent a wonderful opportunity to present all manner of fascinating work.

There are three "flavors" of sketches: Technical Sketches, Artist/Designer Sketches, and Animator Sketches. They are designed as adjuncts to the Papers session, The Bridge: SIGGRAPH 96 Art Show, and the Computer Animation Festival, respectively. Sketches were originally designed to be short, informal talks, to encourage blue-sky thinking and discussion. This year, for the first time, we are publishing selected sketches as one-page extended abstracts here in the Visual Proceedings. There are several reasons for this:

1 Due to the increasingly high standards for both content and presentation, it is more difficult than ever to get work accepted in the Papers session.

2 The art show and Computer Animation Festival are similarly exclusive.

3 An artwork or animation may benefit from verbal annotation.

4 Published sketches are designed to accommodate such discussions, as well as to provide an archival reference to new and/or modest but worthwhile technical results. They also provide an outlet for whimsical and comical presentations that are just plain fun.

We intend sketches to foment thought, conversation, and mirth among attendees, and to inform them of mature, significant work. To accommodate this range of content, we are presenting works designed and submitted as sketches, and invited talks based on published journal papers. A journal publication may be prestigious, but it does not generally come with an opportunity for public presentation at a high-profile event like the annual SIGGRAPH conference. Also, many who would not find the time to read a journal paper might take the time to hear a 15-minute talk on the topic. We're providing such opportunities in the SIGGRAPH 96 Sketches.

Also for the first time this year, Sketches have a champion on the SIGGRAPH Conference Committee: The Sketches Chair. We can thank the SIGGRAPH 96 Conference Chair, John Fujii, and the Conference Coordinator, Molly Morgan, for having the vision to make this possible. I sincerely hope that this is the beginning of a new and valuable tradition in the rich and varied milieu of the SIGGRAPH conference. And we all sincerely hope that you will find the sketches both informative and provocative.

If you like what you see here, remember: You, too, can play with us in this highly accessible SIGGRAPH forum in years to come!

KEN MUSGRAVE
SIGGRAPH 96 Sketches Chair

Technical Sketches Committee

JIM ARVO
California Institute of Technology

LOREN CARPENTER
Pixar Animation Studios

ANDREW GLASSNER
Microsoft Research

DAVID SALESIN
University of Washington

Artist/Designer Sketches Committee

BARBARA MONES-HATTAL
George Mason University

LYNN POCOCK
Pratt Institute

Animator Sketches Committee

DAVID BARAFF
Carnegie Mellon University

NED GREENE
Apple Computer, Inc.

Cosmic Voyage: Scientific Visualization for IMAX Film

"Cosmic Voyage," funded by the Smithsonian National Air and Space Museum (NASM) and the Motorola Foundation, with additional support from the National Science Foundation (NSF), and a production of Cosmic Voyage Inc., is a visual story about the relative size of things in our universe, from galactic clusters to quarks. The production debuts in August 1996 in Washington, D.C. Its many technical firsts include more computer graphics imagery (CGI) and scientific visualization (SV) minutes than any other narrative IMAX movie. Each IMAX frame is about 10 times the area of a standard 35 mm film frame. This is a major CGI challenge, given the 4K pixel resolution for an unforgiving film format (the slightest error is magnified by the scale of screen pixels).

Donna Cox, Associate Producer for Scientific Visualization and Creative Director for the Pixar/NCSA segment of the film, orchestrated a major collaboration among Pixar Animation Studios, Princeton University, the University of California at Santa Cruz (UCSC), the National Center for Supercomputing Applications (NCSA), Santa Barbara Studios, the Electronic Visualization Lab (EVL) at the University of Illinois at Chicago, and the San Diego Supercomputer Center (SDSC) to produce data-driven supercomputer visualizations.

Scientific Simulations

Frank Summers of Princeton computed an ultra-high-resolution galaxy formation simulation of the early universe. The simulation is two million particles/time step and reveals the condensation of matter along filaments that form galaxies (see Figure 1). It represents two billion years and required an NCSA supercomputer running all processors for one month, which generated 120 gigabytes of raw data.

A galaxy-collision simulation was computed by Chris Mihos and Lars Hernquist, UCSC. They modeled gravitational interplay among 250,000 galactic particles, including density and star formation resulting in the collision and final merger of two spiral galaxies (see Figure 2). SDSC donated over 750 Cray C-90 hours to this project.

Virtual Reality Choreography

Robert Patterson, NCSA visualization and virtual environment designer, and Cox collaborated with Marcus Thiebaux, EVL virtual environment research programmer, to develop a voice-driven virtual reality choreographer (Virtual Director) using the CAVE: a 10-foot-cube room with stereo rear-screen projection that allows total immersion in 3-D CGI. Patterson choreographed the simulations for "Cosmic Voyage" with Virtual Director, which provides an intuitive interface for the user to navigate through simulations and position/edit camera key frames in a virtual environment (see Figure 3).

Pixar Rendering Software

Loren Carpenter, Pixar senior research scientist, developed the Star Renderer, a special-purpose software to efficiently render particles from the above datasets. This software renders realistic SV that audiences can relate to Hubble photos. CGI rendering control is analogous to telescopic viewing control of observational data. Parameters include exposure, parsecs/unit, and star magnitude. The Star Renderer also incorporates advanced techniques such as motion blur that are very important for prevention of large-format strobing.

Visualization and Film Recording

Erik Wesselak, NCSA visualization software programmer, developed an interface between the massive data sets, the Pixar Star Renderer, and Virtual Director. This interface samples/formats data and allows separate control of more than 30 parameters. Using this interface, Cox and Patterson aesthetically designed realistic galactic imagery.

The raw data totalled more than 150 gigabytes and required online access to render animation tests. 4096 x 3002 pixel resolution generated final IMAX frames that ranged from 10-30 megabytes each. These large data volumes required NCSA's massive storage/network capabilities. Thousands of images were stored to scsi disks and transported to Santa Barbara Studios, where they were recorded to IMAX film.

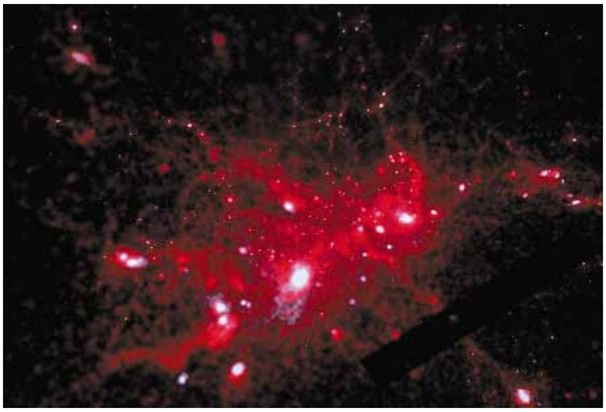


Figure 1 Galaxy Formation

Figure 2 Galaxy Collision

Figure 3 Patterson and Cox inside Virtual Director

Photo by Jeff Carpenter

Contact DONNA J. COX

National Center for Supercomputing Applications
University of Illinois at Urbana-Champaign
cox@ncsa.uiuc.edu

SoRender is a graphical interface from Softimage 3D to the RenderMan standard. It is designed to seamlessly integrate the two packages without compromising either the ease-of-use of Softimage or the power of RenderMan.

The Texas A&M Visualization Program brings artists and scientists together and teaches them to both work and communicate together in the realm of 3D computer graphics. One hindrance to the success of this goal was the lack of a computer animation package that was friendly enough for artists to use, yet verbose enough for programmers. Commercial packages were often easy to use, but did not provide the power and flexibility that programmers were looking for. The RenderMan standard provided such power and flexibility, but it lacked the intuitive user interface that artists wanted. The lab did not possess an interface between the two that could satisfy the desires of the artists and the needs of the programmers. The solution was to develop such an interface ourselves. Softimage was chosen as the animation package for two reasons. First, its developer's kit was adequate to support such an undertaking. And second, it was (by far!) the preferred animation package in the lab.

Because our goal was to enable artists and technicians to work together, we realized there were two principles we must always adhere to. The first and easier to observe was that we could not limit the power and flexibility of the RenderMan standard. The harder challenge was that the interface had to be easy for artists to use. In order to achieve the second principle we set the following goals:

1 All tools to the interface should be graphical.

2 All tools should be accessible from within the Softimage 3D environment.

3 Access to the RenderMan environment should feel like an extension to the Softimage environment, as opposed to a separate environment.

4 Tools should be designed to function the way artists want them to function, and not the way programmers find most convenient.

5 Artists should be involved from the beginning in the design of the interface.

The interface itself currently consists of eight tools, which are implemented as custom effects in the Matter Module of Softimage 3D:

1 Xshade is a tool for attaching RenderMan shaders to geometry. When a shader is attached, its parameters are parsed and a graphical user interface is built on the fly that provides sliders to control the values of the parameters. The user has the ability to edit the source of the shader, recompile the shader, and preview the RenderMan-rendered image with the modified shader applied to the current Softimage frame with all lights and geometry in the scene.

2 Qshade is identical to Xshade, except that the modified shader is previewed on a selected model with a precomputed camera orientation and lighting model. Size of the preview, camera dolly, and object orientation can be changed before previewing.

3 Xlight is similar to Xshade, except that it applies light shaders to lights.

4 WriteRib writes out a frame range of RIB (RenderMan Interface! Bytestream) files that contain all of the necessary information to produce a final rendered image.

5 WriteZ writes out Z depth information RIBs that can be rendered to create shadow maps.

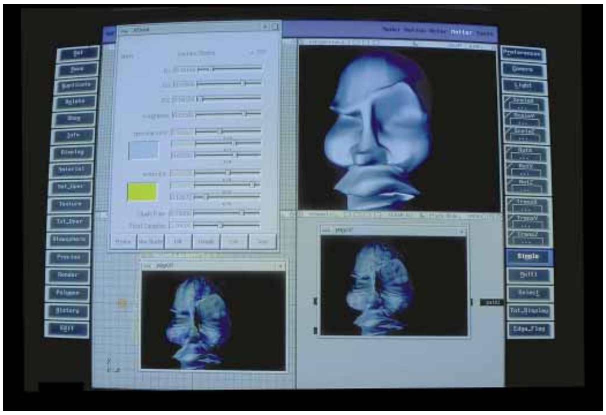
6 ShadowCube generates RIB files that when rendered produce six separate shadow maps that can be used with light sources that require multiple shadow maps to render correctly.

7 WriteEnv generates RIB files that when rendered produce cubic environment maps.

8 GlobalOptions is used to set image format and provide seamless switching between PhotoRealistic RenderMan and Blue Moon Rendering Tools as a renderer accounting for most of their differences of implementation.

An additional feature of SoRender includes hierarchical inheritance of shaders (useful for preserving shader space across different models). There are several keywords that when used as parameter values to RenderMan shaders will take their values from Softimage instead of the user interface. For example, "diffusecolor," when used as a parameter, takes its value from the diffusecolor of the material at the current frame. This enables such parameters to be animated easily. Also the parameter "shadowname" always looks for shadow maps of a particular naming convention supported by the WriteZ tool. The burden of keeping track of different shadow maps for different frames is then removed from the animator.

It is perhaps too early to comment on the ultimate success of this project and whether or not it will enhance the relationship of artist and technician working together on animation. However, while the RenderMan standard was virtually unused in the spring of 1995 at the A&M Vizlab, there are currently 12 students using the SoRender interface to render Softimage scenes with the RenderMan standard. Of those, eight are artists and four are technical.



SoRender Interface inside Softimage 3D showing PhotoRealistic RenderMan preview.

Contact

DAVID WALVOORD Texas A&M Visualization Laboratory
416F Langford C Texas A&M University College Station, Texas 77843 USA
+1.409.845.3465 +1.409.845.4491 fax davew@viz.tamu.edu

By at least some measures, recent progress in the area of automated motion synthesis has been remarkable: a variety of land and sea creatures have been made to walk, waddle, wiggle, bounce, bound, and slither automatically. Yet, viewed from a broader perspective, this progress seems illusory: there is little evidence that automated motion synthesis can be used to express emotion or to tell a story, which are the ultimate success criteria for creative animation. Our goal was to provide some evidence to this effect. We scripted a story in which variation and quality of character motion are crucial and then created the motion in each cut solely by automatic means.

The Story

The dance floor is empty except for the presence of a chair and a small – some would say attractive – end table. The chair, a bit oafish but ever the optimist, has had his eye on the table for the entire night, and now they are alone. The silence is broken as the next song begins and the unmistakable theme of "Stayin' Alive" is heard. The end table, aloof but well aware of the chair's attentions, has a game in mind. She begins to dance, inviting imitation. The chair, like many a Travolta wannabe before him, takes up the challenge. Undeterred by her skill, he mimics her moves with some lumbering steps of his own. As the tempo increases, the chair manages to keep up. In fact, he thinks he is doing rather well. Soon, however, the end table grows tired of the game. She raises the stakes, demonstrating an athletic pirouette. The chair, obviously shaken, is not prepared to give up easily, having come this far. His pirouette has all the elegance of a car crash, but it's good enough, he hopes, to maintain her interest. Once again, it is the table's move. She completes a forward diving somersault, showing off years of dance and gymnastics training. The chair collects himself: this is no time to be faint of heart. He crouches, then throws himself into the move, jumping up and twisting for all he's worth. But it is not to be, and he falls on his face, defeated. As the song concludes, the table struts away without so much as a backward glance.

Tools

Our particular approach to automated motion synthesis is described in detail elsewhere .[1] Here we consider only the inputs required by our system.

One input comprised the physical models for the characters. For the end table we used a compact, symmetric mass-spring lattice. The chair was modeled by adding a back and supporting springs to the top of the cube. The other input consisted of objective functions for each of the 11 different motions required by our script. Through previous experimentation, we had developed a set of about 20 objective-function terms that measured such motion characteristics as average distance traveled, maximum height cleared, rotation about an axis, average symmetry of a gait, average asymmetry of a gait, contact with the ground, etc. We were able to construct an objective function for each of the desired motions using combinations of these terms. Usually, our search algorithm found a motion that was near-optimal with respect to the given objective function. However, at the beginning we frequently underspecified the objective functions, which led to unusual and unexpected motions. One or two of these were included in the animation (e.g., the table's shimmy-like rotation is an underspecified pirouette), but most were not. After some experience, our skill at specifying objective functions increased, and our efficiency improved.

Conclusion

From conception to final editing took five days, most of which were spent waiting for our computers to report results. Although modest in scope, the resulting animation is something that we could not have produced on our own in any other way, given our profound lack of artistic and animation skills. Based on this experience, we remain optimistic that automated motion-synthesis techniques can lead to useful tools for the animator.

References

1 J. Christensen, J. Marks, and J. T. Ngo. Automatic motion synthesis for 3D mass-spring models. The Visual Computer, to appear.

JON CHRISTENSEN
University of California, San Diego

JOE MARKS
MERL

J. THOMAS NGO
Interval Research

Contact
JON CHRISTENSEN
Department of Electrical and Computer Engineering
University of California, San Diego
3050 Urey Hall Addition
9500 Gilman Drive
La Jolla, California 92093 USA
+1.619.642.0343
+1.619.534.7654 fax
jmc@ece.ucsd.edu
http://sdchemw1.ucsd.edu/~jmc.

The butterfly animation described in this summary was produced at Sony Pictures Imageworks for Columbia's feature: "The Craft." The significance of this piece is that it was created entirely on the PC platform using 3D Studio R4 and rendered in the 16 bits/pixel color depth aspect with proprietary SPI software (a first for the PC). While an SGI workstation running Wavefront, Alias, or SoftImage would normally be the producer's choice for an effects shot of this magnitude, budgetary restrictions on "The Craft" allowed us to attempt a PC-based solution where it otherwise may not have been considered. The end result is a very convincing effect that audiences will be hard-pressed to recognize as CGI (especially PC-generated CGI). Details on the following summary can be found in the June issue of *Computer Graphics World* and at http://www.sonypic.com/imageworks.

Background plates: Two sets of plates were delivered to us with guidelines for the CG butterfly elements. In the first shot (a long-shot of a group of girls sitting in a field), a swarm of monarchs enters the frame from above. Cut to shot two (closeup of two girls): hundreds of butterflies continue to descend into the scene. CG shadows must also fall on the girl's faces and in the surrounding area. One actress reaches forward for a CG butterfly that lands on her hand while a second one lands on her sleeve.

Stand-in geometry: Stand-in geometry for the girls had to be created (and animated) as matte objects to mask the CG butterflies that fly behind them. It also serves as a three-dimensional reference for the butterfly choreography and is used to receive shadows in a later step.

Choreography and Tracking: The sight lines and "reactions" of the actresses to the imaginary monarchs is what dictated the motion paths of the animated butterflies. The stand-in geometry became the tracking reference for the butterfly that lands on the girl's hand (because it was already animated as a matte object for the scene). In this case, the butterfly mesh was simply linked to the model's hand after landing.

Depth-of-field: The Z-Focus IPAS routine in Digimation's LenZFX 2.0 was used to selectively blur each of the three foreground layers of butterflies to simulate the camera's depth of field.

Shadows: Shadows were cast into the 3DS scene and rendered as an entirely separate element. This resulted in white butterfly shadows (only) moving over the contours of 3DS geometry in a solid black environment. Custom code (.IXP) was written to lower the luminance values in the background plates in direct proportion to the levels of white in the animated shadow map.

Final Composite: All of the elements were composited in Video Post. This includes the main butterfly animation, three layers of foreground butterflies, and two levels of shadows. Custom code was used to read and write the Wavefront RLA format (16 bits/pixel) in the final rendering for film.

Contact
DAVID SCHAUB

Sony Pictures Imageworks
10202 West Washington Boulevard
Culver City, California 90232 USA
+1.310.280.7603
+1.310.280.4397 fax

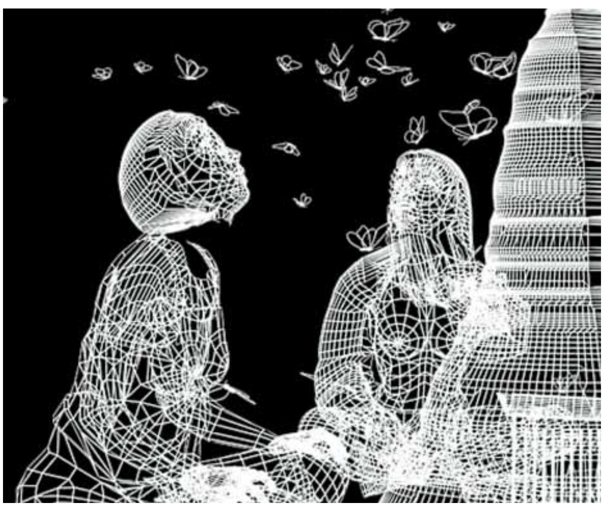


Figure 1

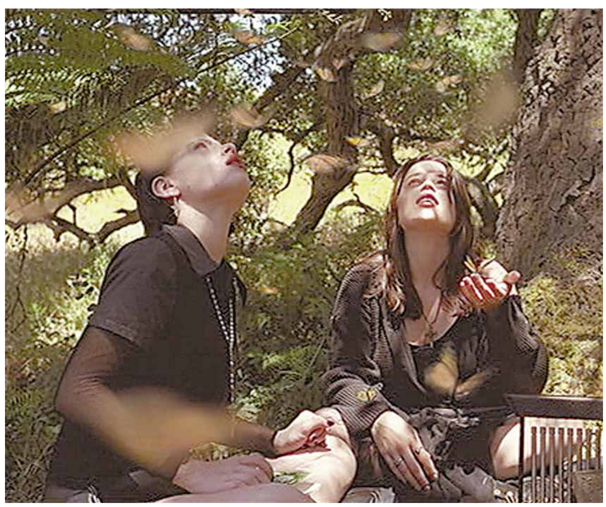


Figure 2 Fairuza Balk (left), Neve Campbell (right)

Homer^3: The Simpsons Halloween Special (Treehouse of Horrors VI)

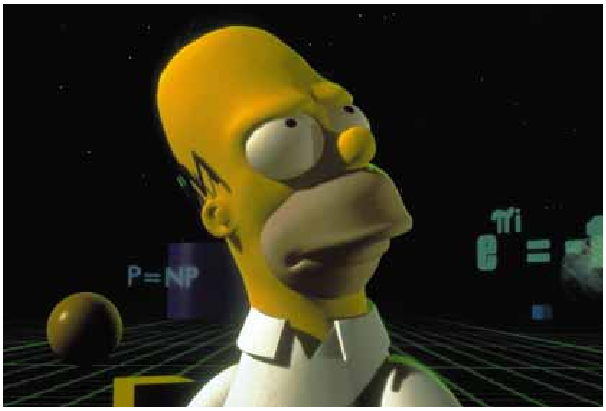
Working on the Simpsons "Homer^3" was an unusually fun project for the team at PDI. Not that other projects aren't fun, but this was a special opportunity. We are all big fans of The Simpsons, and this was a chance to do something that no one has done before: bring the much-loved two-dimensional characters into (cue the scary music) The 3rd Dimension.

PDI produced just over 3.5 minutes of computer animation for the "Homer^3" segment of the 1995 "Treehouse of Horrors VI" Halloween special. Production took place over the course of four months, with a core team consisting of a director, a producer, a technical director, three character technical directors, three lighting specialists, eight character animators, and nine effects animators. Because everyone at PDI was excited about the project, we opened it up to as many people as possible, but at any one time, there were around 10 people dedicated to the "Homer^3" segment.

One of the joys of this project was that the ultimate goal was to make it funny. The idea behind the environment that Homer enters after passing through "the mystery wall" was a send-up of computer animation. The challenge was to make imagery that parodies our craft yet still produce images that we could be proud of. So we started with a grid that is meant to be reminiscent of "Tron" and "The Black Hole." The grid allowed us to use a pulsating green fill light to add to the ominous feeling of this dimension. To fill out the space, classic CG primitives (cubes, cones, cylinders) were scattered about, and various equations hovered mysteriously in the air. Die-hard fans and the nerdy among us will recognize and decipher the hexadecimal ASCII phrase that Homer passes (provided compliments of the Simpsons writers). Each equation has some sort of meaning. One is the director's favorite number, and we couldn't help adding 734, which spells PDI on a telephone keypad. The very observant viewer will also recognize that Homer strolls past the library from "Myst" and that the SIGGRAPH teapot is placed in the background of one scene. (Our R&D staff carefully researched the proper color and handle placement for the teapot.)

Another major challenge was to create three-dimensional characters that the audience would immediately identify as the Homer and Bart they know and love. In the modeling phase, we contracted Viewpoint Data Labs to work with us on the models of the two characters. A number of surprises emerged in the process of taking the characters from our 2D cell reference to 3D geometry. We found ourselves saying: "Oh, my God, Bart's hair looks like a bunch of little cones on the top of his head. Wait, Bart's hair IS a bunch of little cones on the top of his head. And Homer's hair is a couple of M's glued to the sides. And Homer's eyes are these HUGE spheres that initially had 3D pupils that made them look like, well..." After a few iterations, we felt that we had the models nailed, and character setup began.

On one hand, you would think the actual character setup would be a fairly simple matter, given that the characters themselves are fairly simple, but that simplicity was misleading. Because the characters are smooth, clean, and "cartoony," the deformations had to be finely honed to maintain that look. Of special interest, the facial system was an elaborate combination of model interpolation and custom controls. This allowed the character animators to quickly rough in lip-sync based on the exposure sheets that the Simpsons people provided. A series of mouth shapes was modeled to correspond to Homer's basic expressions as they appeared on the "model sheet" and were referenced by a letter on the exposure sheets. The custom controls allowed the character animators to fine tune the expressions. We knew that we had successfully brought Homer to life in the third dimension when our clients exclaimed: "You've stolen Homer's soul!"



3D Computer animation by Pacific Data Images.

The effects work on the project was also a challenge. Due to the schedule and the number of effects, our fx team had to be very efficient. They were told: "If it's going to take two or three weeks (to pull off a certain effect), then you'll have to re-think it." Also, to achieve the look we wanted, clean and simple was the key to success. The list of tasks included: the mystery wall 2D/3D transformation, a growing black hole, a pool of water, a drooling Homer, a rippling belly, a stretching face, and an effect when, according to Bart: "The universe sort of collapsed on itself." For example, the water in the pool was a fairly simple technique. A mesh of polygons was displaced by slices of a block (or slab) of three-dimensional noise. With the proper lighting, this simple effect gave us the look we were seeking.

Our final challenge was to bring Homer to "the scariest place yet" – a live-action scene shot on location on Ventura Bouelvard in Los Angeles. Initial plans called for a person in a "Homer suit," but we used our CG Homer instead. A team from PDI attended the shoot so that we could make sure the we had the right elements to seamlessly place Homer in that environment. Measurements were taken so that we could simulate the camera and surroundings on the computer. Mock models of the buildings and awnings were created for lighting and generating the correct shadows. Our goal was to give Homer a different look than he had in the third-dimension grid. To achieve this, a different lighting specialist was assigned to work exclusively on the three live-action scenes. The animator started with a clean slate, creating new textures for mapping on the live-action Homer. At one stage, Homer had plaid pants, which actually looked very funny, but they were too far out of character. Instead, he ended up wearing a normal pair of blue jeans.

The "Homer^3" project was a pleasure to work on. It offered the PDI team both technical and creative challenges and, basically, was just plain fun. It gave us a chance to advance our craft while at the same time, poking fun at ourselves and our industry. Anyone connected to the CG field can certainly appreciate the irony when Homer exclaimed: "Man, I feel like I'm wasting a fortune just standing here."

Contact
KEN BIELENBERG *Senior Animator*

Pacific Data Images 3101 Park Boulevard Palo Alto, California 94306 USA
+1.415.846.8100 +1.415.846.8103 fax info@pdi.com

This presentation describes the author's use of stereoscopic computer imaging procedures to construct artworks that explore the viewer's relationship to virtual/pictorial space.

An interest in the uses and function of linear perspective initially led me into the realm of 3D computer modelling in 1991. Simple virtual objects were constructed using commercially available software, and the viewpoint was manipulated interactively in order to produce images that subsequently formed the basis for paintings and prints. The experience of real-time engagement with virtual objects (which consist essentially of digital coordinates/descriptions and whose visual form can only be apprehended via representation) led me to consider how such objects related to the mental concepts or pictures upon which they in turn were modelled, specifically in terms of picturing (the ways we create, perceive and interpret pictures). This interest has formed the basis of a research project that aims to question the relationship between observer and observed image: How do we (visually) represent the world? How do these visual images relate to the language we use to describe them? And to what extent do pictures resemble or relate to the world they depict?

Two eyes provide us with a means (though not the only means) of establishing our position in the world. We can say with some confidence that we are here, and the world is there. Stereoscopy is a visual device that exploits this aspect of our physiognomy. It provides a means of bypassing the conventional way in which we look at pictures by dissolving our awareness of the picture surface. An analogy can be found in Fra Andrea Pozzo's painting "The Glory of Saint Ignatius" (1691-4) on the hemispherical ceiling of the church of St. Ignazio in Rome.[1] When viewed from a specific point marked by a yellow disc on the floor of the church, the painted architecture and space appears as a continuation of the actual architecture. Unable to determine precisely where the picture surface actually is (as a result of its distance and irregular shape), the viewer mistakes the painting for what it represents. Stereoscopy, likewise, is a two-dimensional form with aspirations to the third dimension. In order for such a picture to be effective as a representational illusion, it must to some degree be consistent with what we would see of an object/world from a given point of view. Just as perspective pictures describe not how we see but what we see from that given point, stereoscopic pictures manipulate what we think we are seeing by isolating each of the images given to our separate eyes. By severing this physical link, or rather by accentuating the natural division between left and right, they direct information as much towards the brain as towards the eyes.[2]

Discovery of a stereoscopic drawing aid in which the virtual, three-dimensional image appeared to stand vertically up from the page as if mimicking an actual object led me to consider combining the use of stereoscopy with another eccentric visual device, anamorphosis.[3] George Whale, a programmer colleague at Chelsea School of Art, and I have subsequently developed an anaglyph extension to a CAD application in which stereoscopic left- and right-eye images of a 3D computer model are projected onto a user-defined picture plane or planes in a manner reminiscent of the way an object's shadow is cast on a surface by a point light source. Objects constructed in a variety of 3D modelling applications are imported as DXF files, and the desired perspectival viewpoint is located through either visual manipulation or numerical input. The user is presented with options regarding the intended plane(s) of projection, angular separation between left and right eye viewpoints, and wireframe or hidden-line rendering. As the first of these options may suggest, multiple-projection planes may be employed with the stereoscopic images, for example, being projected across the juncture between floor and wall or across the surfaces of a cube.

Steps (1996) was initially intended as a life-size stereoscopic image to be displayed on the floor and wall of a gallery space, and it was therefore necessary to work to scale from the outset. A model with the desired dimensions was constructed in a 3D modelling program together with surface planes representing the floor/wall and guidelines indicating the required viewing position. This information was imported into the CAD package and the desired viewpoint – detailing viewer distance and height – was input numerically. Small-scale proofs were output on a desktop plotter fitted with appropriately coloured red/green pens and viewed with corresponding glasses. Some experimentation was necessary to determine the appropriate angle of separation relative to viewpoint, as when the images were enlarged, so the viewing distance and height increased. Actual size proofs were printed using an A0 inkjet printer fitted with specially mixed inks, which proved invaluable in establishing the most successful combinations of distance, height, and angular separation. Black and white film positives were subsequently made from the resulting EPS files, and the final image was printed by hand using screen-printing processes.

Steps (1996) installation views

This work (together with other similar pieces) aims to draw attention to the artifice inherent in representation and the propositional nature of illusion, and to promote the viewer's active involvement in the construction, perception, and interpretation of visual events.

References

1 For a discussion of this painting with regard to picture perception, see M.H. Pirenne's Optics, Painting, Photography. London: Cambridge University Press, 1970.

2 Julesz has shown that the brain does not rely on or necessarily require information about object shape/contour in order to perceive depth, but on point-to-point disparity between similar images. See B. Julesz. Foundations of Cyclopean Perception. Chicago/London: University of Chicago Press, 1971.

3 See R. Nicyper. Phantogram Perspective Charts. Westport, Connecticut: Graphicraft, 1979.

Contact
TIM O'RILEY
Chelsea College of Art and Design
Manresa Road
London SW3 6LS
UNITED KINGDOM
+44.171.514.7750
+44.171.514.7777 fax
tim@chel-vr.demon.co.uk

ParkBench kiosks address the problem of elitism in cyberspace. The Internet's information and connectivity resources seem to promise universal access. Our aim is to reach out to those who lack the prerequisites for getting online.

Worldwide, it has become obvious how technology widens the gap between haves and have-nots. From our experience introducing disadvantaged students to digital graphics, audio, and Web authoring programs, we are convinced of technology's power to unlock creativity and enhance self esteem. The Internet reflects a dynamic portrait of its creators. If it is to evolve to represent our global culture, we all have a responsibility: public art must become the public's art.

ParkBench kiosks are currently under development at 14 public schools, where we are training teachers and students in visual and Web literacy. Their first project is to create a journal of Visual Poetry. These artworks will serve as the catalyst for discussion among sites. The kiosks, located in school libraries and computer labs, will be open at selected times to family, friends, and other community members. Students will serve as turnkey instructors, passing on their own knowledge. We will complement this network with kiosks at other accessible sites in New York, including museums, libraries, public atriums, and transit stations. Student-teachers will serve as hosts at these kiosks, introducing the public to Web literacy, showing their work, and demonstrating their knowledge to a public beyond their own communities.

The kiosks' functions include Internet access via the World Wide Web, videoconferencing among sites, collaborative drawing, an electronic bulletin board, and email.

Alice Sat Here

We collaborated with a team of New York University computer scientists and engineers to equip a wheelchair with a wireless telerobotic camera. The result, *Alice Sat Here*, was shown in November 1995 in CODE, at Soho's Ricco/Maresca Gallery. With gallery visitors steering Alice's Throne and remote participants controlling camera direction, *Alice Sat Here* was a passage between the physical world and cyberspace. Participants converged from Web-side and street-side, explored parallel spaces separated by glass, and peered through the membrane at each other's representations.

Alice's Throne

Interactors at the front window were digitally inset into images grabbed by the mobile camera. This image was downloaded from the Web.

Design Engineer Fred Hansen designed and fabricated the servo-controlled unit for Alice's camera, in addition to mounting and powering all accessories to Alice's Throne. Toto Paxia and David Bacon collaborated in design and implementation of Alice's client/server architecture, which ran on two PCs networked locally at the gallery, connected via PPP to the gateway server at NYU. One PC, running Windows, housed video and touchpad servers; the other, running Linux, was the pointing motor/network server. Video was sent wirelessly from the throne's camera to the video/touchpad server, displayed on a monitor in the front window in real time, then sent to the pointing motor/network server, and from there to the gateway server, where it was made available to Web users. By touching the pads in the front window, participants sent camera directions to the video/touchpad server, which passed them to the pointing motor/network server, where they were processed by a custom board built by Paxia and sent to a remote-control device that used radio waves to control the up/down and right/left position of the videocamera's servomotors.

Thursday Night Performances: ArtisTheater

We envision each kiosk as a miniature television studio transmitting to other kiosk sites and to Web users. We have been experimenting with this medium during our *Thursday Night Performances*, which are visible at http://c4dm.nyu.edu/parkbench/Thurs8.html. By using puppets, sculpture, painting, dance, and cooking – along with guest artists, including students from the Lexington School for the Deaf – our aim has been to determine what kinds of performance are viable in this medium.

When we began experimenting with Richard S. Wallace's telerobotic camera in 1994, it was one of the first on the Web, and it inspired our performance series. Fred Hansen designed and manufactured LabCam's Spherical Pointing Motor.

Image downloaded from ArtisTheater

ParkBench is the most recent in a series of public video installations by artist, performer, and lecturer Nina Sobell. Emily Hartzell is a multimedia artist and curator ("At the Intersection of Cinema and Books" and "Woman on Earth"), who also collaborates on design and manufacture of input devices for artists. They are currently producing Iris prints derived from their live Web performances.

Contact NINA SOBELL & EMILY HARTZELL *Artists in Residence*
NYU Center for Digital Multimedia 719 Broadway, 12th Floor
New York, New York 10003 USA +1.212.998.3395
parkbnch@large.cs.nyu.edu http://c4dm.nyu.edu/parkbench

A Small Step/Giant Leap Toward True Interactivity or We Shall Overcome the Limits of Technology

SPACE|R A C E, an interactive multimedia piece about the 1960s U.S. Civil Rights movement and space program, encourages viewers to experience paradox and ambiguity as natural parts of human existence in a complex world.

"I am happy to join with you today in what will go down in history as the greatest demonstration for freedom in the history of our nation."

Opening of Dr. Martin Luther King, Jr.'s "I Have a Dream" speech, August 28, 1963

"One small step for man. One giant leap for mankind."

Neil Armstrong, July 20, 1969

"This is the greatest week in the history of the world since the creation."

President Richard Nixon, week of the moon walk, July, 1969

About 500 million people around the world watched the first moon walk on television. "I Have a Dream" is one of the best-known speeches of modern times. How are these monumental shared pieces of our history remembered by different kinds of people? Using a broad range of memories about both events, I am experimenting with simulated conversations between those who probably would not otherwise exchange stories in our socially stratified society.

Most current interactive computer works are limited by what the creators have input. My piece allows viewers to "interact" with other points of view and add their own memories to the database of responses.

Perceptions have increasingly replaced information in public discussion of issues. Clearly perception-based, this piece puts different points of view right next to each other somewhat randomly and without editorial comment to examine the relationships between "facts," perceptions, cultural mythology and "reality." I hope to present varied points of view from a particular time in history without moralizing or solving specific problems. Multimedia is a perfect way to juxtapose alternative realities and show their respective inherent seductiveness.

Cultural mythology in the United States tells us that the space program is noble and necessary, vital to national security, science, and "progress." In fact, the number of U.S. citizens who are ambivalent about or opposed to the space program has always been about equal to the number who vehemently defend it.

The Civil Rights movement is largely perceived by white Americans as the solution to our societal race problems and relevant only to African-Americans. There was no concerted national effort made, aside from legislation, to change the cultural dynamics of institutionalized racism, which is widely perceived to be nonexistent. There are always contrasting realities.

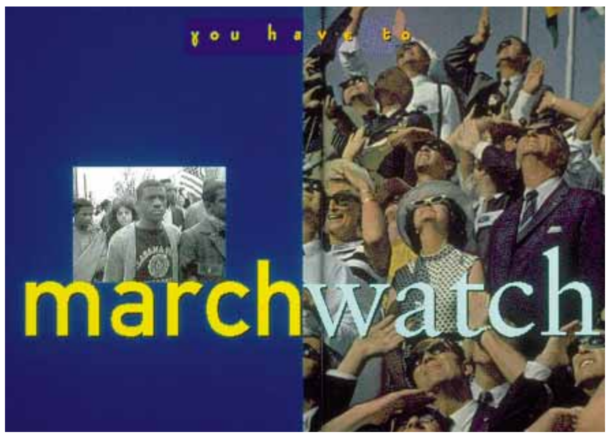
Looking at media coverage of the space and race stories shows the real-time, resonant impact of broadcasting on the first TV generation. Those who watched the moon walk on television as it happened feel that they were somehow part of the event. When parts of the "I Have a Dream" speech are broadcast on Martin Luther King Day or when a child recites it in school, the words are reinforced as part of our history and value system.

Both of these historic endeavors, in space and in human rights, are remembered as examples of what is good about the U.S. as a society. In contrasting the two movements, questions of meaning arise. How do the values of courage, freedom, striving toward moral and scientific ideals, persistence in the face of setbacks, and resistance to the status quo play out differently, or the same?

I believe that the most fascinating possibility for art in "public" spaces via computers is the potential for true interaction among viewers and the creator. Communication no longer has to flow in one direction from artist to audience. Right now, interactive computer works fall somewhere within a range of singular-voice "private broadcasts" and collective "public conversations." The truly interactive visual public conversation is still evolving as an art form. I hope that my experiment with *SPACE|R A C E* is another step toward creating true socially engaging interactivity through computers.

Contact
COLETTE GAITER

Minneapolis College of
Art and Design
2501 Stevens Avenue South
Minneapolis, Minnesota
55404 USA
+1.612.874.3608
+1.612.874.3704 fax
colette_gaiter@mn.mcad.edu



My work with telecommunications started in 1985, when I created a virtual gallery that could be accessed via the videotext system. Since 1989, I have been working with Ed Bennett on the Ornitorrinco project of telepresence installations The basic structure of these installations is comprised of a wireless telerobot, regular phone lines (both for vision and remote control), and remote spaces. Viewers become participants as they transport themselves to the remote body and navigate the remote space freely by pressing the keys on a familiar telephone.

Ornitorrinco remote spaces are always built to the scale of the telerobot, inviting viewers to abandon the human scale temporarily and to look at a new world from a perspective other than their own. In our international telepresence event, *Ornitorrinco in Eden*, realized on October 23, 1994, we hybridized the Internet with telerobotics, physical (architectural) spaces, the telephone system, the parallel cellular system, and a revised if literal digital "tele-vision." This enabled participants to decide where they went and what they saw in a physical remote space via the Internet. Anonymous participants shared the body of the telerobot, controlling it and looking through its eye simultaneously.

A new aesthetic is emerging as a result of the synergy of new nonformal elements, such as coexistence in virtual and real spaces, synchronicity of actions, real-time remote control, operation of telerobots, and collaboration through networks. *Ornitorrinco in Eden* integrated all these elements.

I have created other kinds of interactive telematic installations. For instance, in *Essay Concerning Human Understanding* (with Ikuo Nakamura), a bird in a cage has a dialogue with a plant 600 miles away through a regular phone line. Placed in the middle of the Center for Contemporary Art in Lexington, Kentucky, the yellow canary was given a very large and comfortable cylindrical white cage, on top of which circuit-boards, a speaker, and a microphone were located. A clear Plexiglas disc separated the canary from this equipment, which was wired to the phone system. In New York, at the Science Hall, an electrode was placed on the plant's leaf to sense its response to the singing of the bird. The voltage fluctuation of the plant was monitored through a Macintosh running software called Interactive Brain-Wave Analyzer. This information was fed into another Macintosh running MAX, which controlled a MIDI sequencer. The electronic sounds themselves were pre-recorded, but the order and the duration were determined in real time by the plant's response to the singing of the bird.

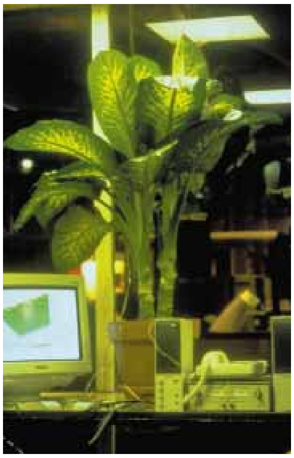
When this work was shown publicly, the bird and the plant interacted for several hours daily. Humans interacted with the bird and the plant as well. Just by standing next to the plant and the bird, humans immediately altered their behavior. When humans were in close proximity, the interaction was further enhanced by the constantly changing behavior of the bird and the plant. They responded by singing more (bird), activating more sounds (plant), or by remaining quiet.

In my presentation, I also discuss the piece I'm showing in The Bridge: SIGGRAPH 96 Art Show, entitled *Teleporting an Unknown State*. This piece connects a physical gallery to the placeless space of the Internet. In the gallery, the viewer sees an installation: a monitor hangs from the ceiling and faces a pedestal, where viewers and participants find a single seed. At remote sites around the world, anonymous individuals point their digital cameras to the sky and transmit sunlight to the gallery. The photons captured by cameras at the remote sites are re-emitted through the monitor in the gallery. The video images transmitted from remote countries are stripped of any representational value, and used as conveyors of actual wavefronts of light.

The process of birth, growth, and possible death of the plant is broadcast live to the world via the Internet as long as the exhibition is up. All participants are able to see the process. Through the collaborative action of anonymous individuals around the world, photons from distant countries and cities are teleported into the gallery and are used to give birth to a small, fragile plant. It is the participants' shared responsibility to care for this plant as long as the show is open.

The telerobot Ornitorrinco in the garden of the Art Institute of Chicago (1992).

A participant from Seattle sharing the body of the telerobot with remote participants in real time on the Internet, as part of *Ornitorrinco in Eden* (1994).



The two sides of the telematic interactive installation *Essay Concerning Human Understanding*, in which a bird in a cage has a telephonic dialogue with a plant in a remote location (1994).

Contact EDUARDO KAC

Department of Art 207 Fine Arts Building University of Kentucky
Lexington, Kentucky 40506 USA +1.606.257.2727 +1.606.257.3042 fax
ekac1@pop.uky.edu http://www.uky.edu/FineArts/Art/kac/kachome.html

Autographic Halftoning for Artist-Printmakers

The "autographic" qualities evident in traditional media, so important to fine-art printmakers, are conspicuously absent from today's digitally halftoned or dithered images, and it is undoubtedly true that the homogenising effect of these methods has deterred many from engaging with new technology. Although some valuable research has been done in developing alternatives to the ubiquitous dot,[1,2,3,4] the need for fine-art printmakers to be able to incorporate their own graphic "handwriting" into the halftoning process has been identified.

As part of a PhD research project into the use of computers in fine-art printmaking, one of the authors identified the tendency for digital halftoning to impart to different images a similar "quality," regardless of image or artist. Unlike computer output, what most distinguishes individual artists' work is not reprographic faithfulness towards the subject, but the manner of depiction, the "handwriting": "…a drawing's basic ingredients are strokes or marks which have a symbolic relationship with experience, not a direct, overall similarity with anything real."[5] With this as a guiding principle, a radical approach has been adopted: verisimilitude has been sacrificed in return for the artist gaining control over the "drawing" processes involved. With images rendered in artists' autographic marks, definition could be sacrificed in order to ally computer technology with drawing and traditional printmaking techniques, instead of more common reprographic techniques. Therefore, while it has been suggested that there is a conceptual similarity between computer image generation and printmaking – multiple copies from a unique matrix[6] – this research has been conducted with respect to the qualitative differences between digital halftoning and autographic printmaking.

The Program

The artist/user must first create a library of characteristic marks/strokes/shapes. These may be digitally painted or scanned from existing drawings, paintings, and prints. The marks are converted into sets of closed, monochromatic polygons by means of a vectorising utility, then saved in PostScript format.

Figure 1 A Look-up Table of autographic marks.

The autographic halftoning program begins by subdividing an imported greyscale image into contiguous rectangular tiles. For each tile, the mean grey value of the enclosed pixels is computed, giving an index to a "look-up" table of artist's marks, and a copy of the indexed mark, suitably scaled and rotated, is placed within the tile. The look-up table (see example, figure 1) is set interactively using marks imported from the predefined libraries, or derived from them by affine transformation and morphing functions built into the program.

The user is also offered a substantial degree of control over the orientation and size of the tile grid, affecting the "flow" of marks across the picture surface, and the level of detail, respectively. The orientation and position of individual tiles can be perturbed to eliminate periodicity, and tile overlap can be adjusted in both dimensions to allow for sparse or dense packing of marks.

The resulting halftone image may comprise tens, or tens of thousands of autographic marks distributed about the picture surface in more or less close correspondence to the original greyscale. Converted images are saved as PostScript files, which can be imageset onto film for high-resolution photo-etching and photo-lithography, or used with a large-format inkjet printer (or even a standard desktop laser printer) to produce inexpensive paper photopositives suitable for screenprinting. Different renditions of the same image (or of different images) can thus be combined, overlaid, coloured, embossed, and otherwise manipulated in the printmaking studio or, given a suitable illustration package, on the computer.

Where digital halftoning tends to "flatten" images, this rich layering of marks allows the image to be built up like an artist's drawing, akin to the processes of hatching. This recalls some of the elaborate techniques of Renaissance engravers, who exploited the potential of optical mixing – that tendency for the human eye to perceive fine distributions of black on white as shades of grey – in order to depict tonality in essentially monochromatic media.

Figure 2 Naren Barfield: Cycladic Head, 1996

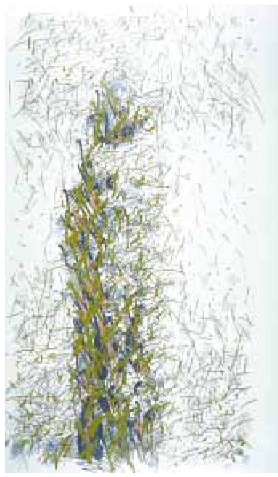


Figure 3 Naren Barfield: Cycladic Figure, 1996

The original images depicted here were created using the autographic software in conjunction with Adobe Photoshop, Adobe Streamline, and Adobe Illustrator. They were printed at large scale (10 feet high) and exhibited at the "Transformations" exhibition in London in March/April 1996.[7] At a distance, the viewer is presented with (if so desired) a recognisable image of greater expressive power than an enlarged halftone reproduction, which upon closer inspection gradually dissolves into a mesh of richly expressive marks varying in length from less than 1mm to more than 30cm.

References

1 G.Winkenbach and D.H.Salesin. Computer-Generated Pen-and-Ink Illustration. Computer Graphics (Proc. SIGGRAPH), Vol. 28, No. 4, Oct. 1994, pp. 91-108.

2 Y. Pnueli and A.M. Bruckstein. DigiDurer - a digital engraving system. The Visual Computer, 10:277-292, 1994.

3 J. Lansdown and S. Schofield. Expressive Rendering: A Review of Nonphotorealistic Techniques. IEEE Computer Graphics and Applications, May 1995.

4 Ostromoukhov, Victor, and Hersch, Roger D. Artistic Screening. SIGGRAPH 95 Proceedings.

5 Rawson, Philip S. Drawing (second ed.), Philadelphia, University of Pennsylvania Press, 1987, p.1.

6 Kerlow, Isaac Victor. Computer Generated Images and Traditional Printmaking. The Visual Computer (1988) 4:8-18.

7 Transformations - the Fine Art Print and the Computer. London, Chelsea College of Art and Design, 1996. ISBN 1 870540 01 8 (Chelsea College of Art and Design).

Contact NAREN BARFIELD & GEORGE WHALE
Camberwell College of Arts London, UNITED KINGDOM

Automatic Video Tracking by Probabilistic Propagation

Tracking is a useful tool for computer graphics, but it has been limited by a lack of robustness. We present a new algorithm that shows greatly improved tracking performance in clutter.

One of the most promising areas of synthesis between computer graphics and computer vision is the field of tracking.[1] If the position and shape of objects can be reliably estimated, this information can benefit graphics applications of various kinds. It is much more natural to describe a stretching or rotating operation in an interactive graphics package using hand gestures tracked by an automatic vision system than to input the same information using mouse or keyboard.

To track agile objects with complex shapes, detailed models of shape and motion are required. For example, when tracking a hand, it is beneficial to build into the tracker information about likely hand shapes and deformations using probabilistic models. This has been done widely in the special case that the probability distribution is normal (Gaussian), by means of the Kalman filter. That approach breaks down, however, in the presence of significant image clutter, which demands a distribution with many peaks, not just one as in the normal distribution. This is because the tracker cannot readily differentiate between true object edges and spurious edges arising from the background. Multiple peaks in the distribution are needed to represent alternative hypotheses about which visible feature belongs to the true object.

A more general representation of probability density functions is clearly required. Previous solutions to this problem, such as the use of Gaussian mixtures and finite element systems, suffer from high computational complexity when the model dimension is large. Data-association methods, such as the RANSAC algorithm and the JPDAF, have been applied successfully to the problem of tracking point features through clutter; however, they cannot naturally be applied when features consist of continuous curves. General representations of probability distributions do exist and have been demonstrated on images of hands[2] and other objects such as galaxies. So far, however, these more general methods, though they are very effective, have been applied only to single images.

The Condensation algorithm (described fully in our paper[3]) develops these methods for use with image sequences. The algorithm uses probabilities and random sampling to track agile objects through densely cluttered environments. It represents an arbitrary probability density function using a sample set of point masses and propagates the set forward through time. The propagation process is efficient; $O(N^2)$ in the model dimension compared with $O(N^3)$ for a Kalman filter, and $O(M \log M)$ in the number of samples in the set. In addition to dealing with image clutter, the algorithm also allows direct implementation of non-linear dynamics and kinematics without the problematic linearisation stage, which is necessary when tracking with an Extended Kalman Filter. Previous applications of random sampling to image processing have tended to consume a great deal of processing time, even with static images. The special structure of our algorithm and its representation of probability distributions ensures that execution is near real-time, even on a modest workstation.

Space does not permit a full treatment of the results obtained using the Condensation algorithm (see our paper[3] and MPEG recordings on the Web site – address below – for a demonstration of the power of the algorithm when following complex motions against cluttered backgrounds). Two challenging tracking situations are illustrated here. First, we show that the Condensation algorithm can follow a moving, jointed hand against the background of a heavily cluttered desk. Next we demonstrate tracking in the extreme case that background objects actually mimic the tracked object. A sequence shows a bush blowing in the wind, where the task is to track one particular leaf. The tracking is accurate enough to separate the foreground leaf from the background reliably, an effect that can commonly only be achieved using blue-screening.

Tracking in clutter is hard because of the essential multi-modality of the measurement distribution. In the case of curve tracking, multiple-hypothesis tracking is inapplicable, and a new approach is needed. The Condensation algorithm is a novel fusion of the random "factored sampling" method developed for single images with stochastic temporal modelling of object motion. The result is an algorithm for tracking rigid and non-rigid motion that has been demonstrated to be far more effective in clutter than comparable Kalman filters. Stochastic techniques are often assumed to be too computationally expensive to be useful for real-time systems. However, the results shown here were tracked in near real time on an INDY 4400 SC 200MHz, and in fact successful tracking of hand motions, provided they are not too agile, can be achieved in real time (25Hz). For more information about contour tracking, including PostScript versions of our papers, see http://www.robots.ox.ac.uk:5000/~misard/tracker.html.

References

1 A. Blake and M.A. Isard. 3D position, attitude and shape input using video tracking of hands and lips. In Proc. SIGGRAPH, pages 185-192, ACM, 1994.

2 Y. Chow, U. Grenander. and D.M. Keenan. HANDS. A pattern theoretic study of biological shapes. Brown University: Division of Applied Mathematics, 1989.

3 M. Isard and A. Blake. Visual tracking by stochastic propagation of conditional density. In Proc. 4th European Conf. on Computer Vision, pages 343-356, Cambridge, England, Apr 1996.

Contact
MICHAEL ISARD & ANDREW BLAKE

Robotics Research Group,
Department of Engineering Science
University of Oxford, Parks Rd
Oxford OX13PJ, UNITED KINGDOM
{misard,ab}@robots.ox.ac.uk

We have developed an anatomical modelling system, based on a finite-element (FE) framework, for creating realistic virtual anatomy for bioengineering and medical applications. The system, described in detail by Sagar,[1] may be used for stand-alone modelling or coupled with FE biomechanical models for simulation and analysis.

Virtual tissue and macroscopic or microscopic organic forms are modelled in a new way as volumes so that internal features may also be defined. The volumes are graphically represented using isosurface methods. To facilitate the modelling of these forms, the established computer graphics techniques of implicit surface modelling, volume sculpting, solid texturing, and free-form deformation have been integrated with nonlinear finite element modelling techniques to create a biological CAD system.

Volumes are modelled in finite-element material coordinates, so that they deform with the biomechanically based finite-element tissue models. This also means that attributes such as textures are linked with material points and deform correctly with volumes.

The modelling system has a Boolean operation/CSG facility that operates directly on the isosurfaces rather than their volumetric definitions to avoid unwanted smoothing and to construct sharp boundaries. A new algorithm performs Boolean operations on a cell-by-cell basis during isosurface generation and has improved performance over the previously employed approach of operating on the surfaces post generation.

The modeller creates multiple-level-of-detail models to meet the constraints of virtual environments. As an example application, anatomical detail is applied to a finite-element biomechanical model of ventricular anatomy to produce a realistic beating virtual heart and graphical visualization of the resulting stress field at the level of the tissue microstructure (Figure 1).

A prolate spheroidal mesh using 60 high-order elements efficiently represents the anatomy of the heart for bioengineering analysis (a: left).

The model takes into account the anisotropy of fibrous cardiac tissue. Fibre angles are shown on the epicardial surface (a: right).

Geometric and graphical realism are added by the CAD system. Volumetric representations of the tissue are mapped into the mesh to represent the complex interior detail. Note the cleanly cut section. which is a feature of the Boolean algorithm (b). (Sections can be made against arbitrary implicit surfaces.)

The atria and great vessels are added to the model, and photographic realism is achieved by interactively applying projected solid textures (c).

The microscopic structure of anatomy can also be modelled. In (d) the shearing deformation of a small cube of heart tissue is illustrated. The computed stress field is used to colour the connective tissue in the sheared state. Note that the internal detail deforms with the element.

Phases of the cardiac cycle have been modelled using the FE model, enabling the virtual heart to beat.

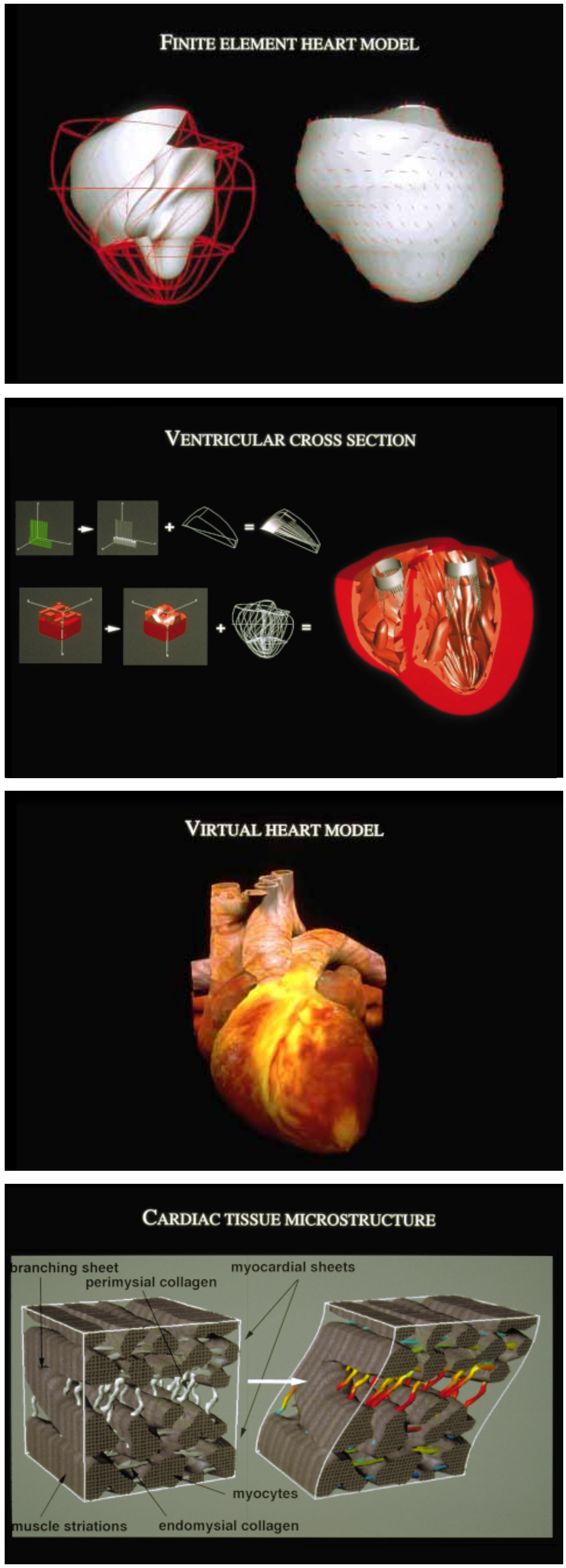
Reference

1 M.A. Sagar, Creating Virtual Anatomy for Bioengineering Virtual Environments, PhD Thesis, The University of Auckland, 1996.

Contact

MARK A. SAGAR & GORDON D. MALLINSON
Department of Mechanical Engineering
The University of Auckland, Private Bag 92019 Auckland, New Zealand

DAVID BULLIVANT & PETER J. HUNTER
Department of Engineering Science
The University of Auckland, Private Bag 92019 Auckland, New Zealand
http://www.esc.auckland.ac.nz/Groups/Bioengineering



a b c d

Figure 1 Images generated by the modelling system while creating a virtual heart.

The goal of the *Distributed ALIVE (dALIVE)* system is to provide a shared virtual space among several computers that allows two or more people to interact visually with autonomous agents ("creatures") and each other. Three requirements affect the system's design:

1 It must work in low-bandwidth/high-latency situations (wide-area networks, for example).

2 It must support distributed computation of the world model.

3 It must provide "approximate accuracy" of each person's view of the world model.

Related Work

Distributed virtual environments are currently a hot topic in the field of computers, and there are many examples of such systems. Mitsubishi Electric's SPLINE focuses on providing a programmatic toolkit supporting 3D sound as well as graphics; the U.S. military's SimNET and DIS focus on realistic, large-scale battlefield scenarios. The difference between *dALIVE* and systems like these is that *dALIVE* focuses on the distribution of behavior-system computations for autonomous agents. Other systems send very low-level geometric information over the network to allow accurate prediction of position and orientation of tanks, vehicles, and other objects; *dALIVE* sends high-level control commands to the geometry of agents instead. In addition, *dALIVE* is geared toward fine-grained distribution of the virtual environment; for example, two apartments in the same building could be "hosted" on different computers to reduce the workload.

Architecture

As described in Blumberg and Galeyan (1995), we use the architecture shown in Figure 1 for our autonomous agents. The Behavior System decides what the creature should do at each point in time and sends these directions to the Motor System in the form of Motor Command Blocks (MCBs), which are small, high-level pieces of information containing commands plus arguments, representing procedure calls. These are interpreted by the Controller and Motor Skills as control commands for the geometry. Human users of the system are represented by avatars in the shared virtual space. Input from humans through a passive vision system replaces the behavior system as the decision maker for the avatar.

When a creature is loaded into the Distributed ALIVE system, the computer on which it was loaded becomes the host for that creature. The host runs a creature's sensing and behavior system, the two most computationally intensive tasks for an agent. The other computers engaged in the same shared virtual space load only the geometrical representation for the creature; these representations are called droids. The MCBs that the master creature generates during each update cycle are sent out over the network. They are received by the droids and executed as normal by the droids' controllers. Thus, the droids mimic the actions of the master creature. From the standpoint of a user or another creature, there is no difference between a master and a droid; this knowledge is contained solely within the master creature.

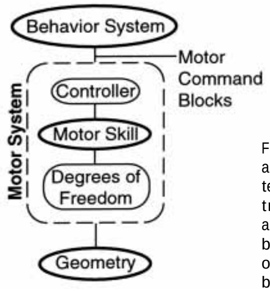


Figure 1 The primary components of the agent architecture are the behavior system, motor skills, and geometry. The controller and degrees of freedom act as abstraction barriers. Communication between the behavior and motor systems occurs in the form of motor command blocks.

Network Protocols

We define the notion of a server that performs two primary functions: it stores the geometry of the environment and all the creatures in it, and it provides a unique identifier for each creature in the environment. However, every computer running the *dALIVE* application can load a new creature into the shared environment; in this sense all the computers are peers.

At the network level, we use two styles of communications protocols to enable these two paradigms (client-server and peer-peer) while reducing network bandwidth. A reliable, full-duplex byte stream is used for sending (relatively large) geometry files between the server and its "clients." Unreliable byte streams are used for sending the MCB packets.

If a client is on the same local network as the server, it can use IP multicasting to send its MCB packets. Otherwise, it uses a point-to-point protocol to send the packets to the server, which redistributes them among all clients. This reduces the number of direct network connections between machines, and, combined with fine-grained distribution of the environment among servers, should scale well to multiple users in the same virtual space.

Demonstration and Future Work

We demonstrated the dALIVE system in the Interactive Communities exhibit at SIGGRAPH 95, with a cross-country link between Los Angeles and the MIT Media Lab over a single ISDN line (56 kbits/sec). In the future, we plan to implement a hierarchically organized virtual environment (an apartment building) with transferral of creatures among host machines as the creatures roam from place to place in the environment. We are also moving toward full integration of an interpreted language into the behavior and motor systems to allow the creation of machine-independent autonomous agents.

References

1 Blumberg, B and Tinsley Galeyan, 1995. Multilevel Direction of Autonomous Creatures for Real-Time Virtual Environments. Proceedings of SIGGRAPH 95 (Los Angeles, CA, August 7-11, 1995).

2 Maes, P., Darrell, T., Blumberg, B., and Pentland, A., (1996) "The ALIVE System: Wireless, Full-Body Interaction with Autonomous Agents", (to appear Special Issue on Multimedia and Multisensory Virtual Worlds, spring 1996)

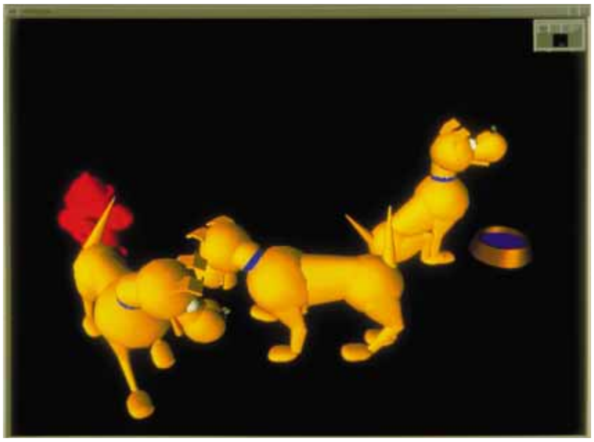


Figure 2 *dALIVE* in action. Each of the dogs is hosted on a separate computer engaged in the shared space.

Contact

KENNETH B. RUSSELL, BRUCE M. BLUMBERG, ALEX PENTLAND & PATTIE MAES
MIT Media Lab
{kbrussel, bruce, sandy, pattie}@media.mit.edu

Several authors have described how to construct a multiresolution surface model by adding wavelet coefficients to a base model in arbitrary order. We present a method that allows one to remove detail from a wavelet description, which is important for interactive viewing of multiresolution models.

Wavelet analysis has been shown to be an effective method for automatically generating accurate models of geometric models at different levels of resolution.[4] An especially attractive feature of wavelet-based models is that the most accurate version of the model already contains all the coarser approximations, so memory is not wasted when storing several models of the same object at different resolutions. Whereas adding or removing detail is usually a discrete event that may cause visible "popping," wavelet techniques allow detail to be added or removed in a continuous fashion.

Meyers[3] and Lounsbery[2] showed how the detail contained in a wavelet coefficient can be added into a polygon and a polyhedral surface model, respectively. However, these authors did not present a method for incrementally removing detail to reduce the polygon count. Certain et. al.[1] have recently developed a multiresolution surface viewer that stores models at different resolutions and then adds detail starting from the most appropriate stored model. In this paper, we present a method for removing detail directly from the current representation without having to regrow the model from a lower detail version.

Adding detail

Let's first review how detail is added into a polygon.[3] In Figure 1, we have a coarse representation of a piecewise linear polygon, and we are about to add a wavelet centered on the 17th vertex. First, we need to add to the polygon all the wavelet vertices that it does not already have (vertices 12, 14, 17). Then we need to add to the wavelet the vertices of the polygon that lie within the support of the wavelet (vertex 21). Finally, we just add the nonzero values of the wavelet vertices to the polygon (vertices 14, 16, 17, 18, 20, 21). Note that depending on which vertices already exist in the polygon, we may have to add anywhere from zero to 7 new vertices for a single wavelet.

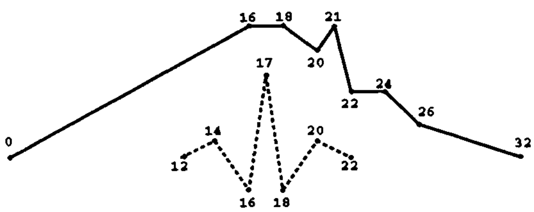


Figure 1 Adding a wavelet creates several new vertices.

Removing detail

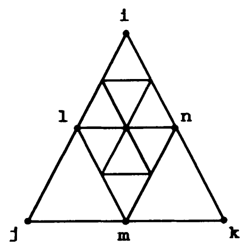
Removing the geometry of a wavelet is easy: add to the wavelet the vertices of the polygon within the support of the wavelet and subtract all the wavelet vertex values from the polygon vertices. The geometry is simpler, but rendering and manipulating the simpler version is as expensive as before. We may be able to remove some of the vertices, but only when the vertex is not required by any of the remaining wavelets.

Our solution for determining which vertices can be removed is to use reference counting: each time we insert a wavelet, we increase the reference count of the wavelet's vertices (in the example, for the vertices 12, 14, 16, 17, 18, 20 and 22, but not 21). When a wavelet is removed, we reduce the reference count. All vertices with zero count can be safely removed.

Generalizing to surfaces

Using this idea for surfaces is somewhat more complicated. As illustrated in Fig. 2, suppose we add a wavelet in the middle of the large triangle (ijk). In order to avoid cracks between the triangles when rendering, it is not enough to add only the triangles and vertices of the wavelet into the mesh; we also need to recursively add the "parent" triangles and vertices (iln, lmn), as well as their parent (ijk) and siblings (jlm, mkn). For more detail, see[1,2]. As in the curve case, the reference count of each wavelet vertex is increased.

Figure 2 Adding a surface wavel



Removing detail is also more complicated for surfaces. Removing the geometry of the wavelet is analogous to the curve case, as is the maintenance of reference counts. However, a vertex cannot be removed when its reference count goes to zero: it may be a parent vertex for some finer level wavelet in the mesh. Four child triangles may be collapsed into a parent triangle if and only if their children do not exist in the mesh, and the counts at the vertices that split the parent's edges are zero. Note that collapsing four triangles may lead to a cascade of further simplifications of the mesh.

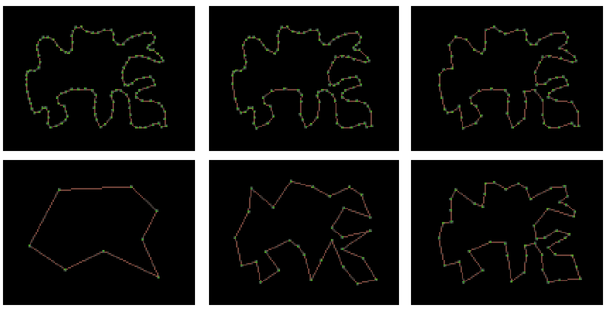


Figure 3 Removing detail from a 2D polygon. The sequence proceeds clockwise starting from left upper corner.

References

1 A. Certain, J. Popovic, T. DeRose, T. Duchamp, and W. Stuetzle. Interactive Multiresolution Surface Viewing. In Proceedings of SIGGRAPH 96, August, 1996.

2 M. Lounsbery. Mult-iresolution analysis for surfaces of arbitrary topological type. Ph.D thesis, Department of Computer Science and Engineering, Univ. of Washington, September 1994

3 D. Meyers. Multi-resolution Tiling. Computer Graphics Forum 13(5):425-340,1994.

4 E. Stollnitz, T. DeRose, and D. Salesin. Wavelets for Computer Graphics: Theory and Applications, Morgan-Kaufmann, 1996.

Contact

KARI PULLI
University of Washington

TONY DEROSE
Pixar Animation Studios

Height fields are a common form of data found in many application domains; terrain elevation and computer vision range data are common and excellent examples. A generalized height field is a surface defined by a function $f(x,y) = (z_1, \ldots, z_d)$. For example, a textured terrain could be described by a function $f(x,y) = (z, r, g, b)$. A discrete height field f_S is defined by a set of sample sites $S=\{(x_1,y_1), \ldots, (x_n,y_n)\}$; f_S matches f at the points of S and uses a triangulation of S to linearly interpolate these values at other points. Typically, the sample sites of f_S are organized on a uniform rectangular grid.

The triangulation of S and the resulting surface f_S approximates the surface f. However, the number of samples is often so large as to make the resulting surface unwieldy. The natural solution to this problem is to select some subset $V \subseteq S$ of "important" vertices and use the resulting approximation f_V. We will present a fast and flexible method for selecting this subset.

Greedy Insertion

We have been investigating the use of an iterative refinement method, which we call greedy insertion, for constructing triangulated approximations of height fields. The algorithm is quite simple and very general; so simple in fact, that it has been discovered in various related forms by a number of people. It begins with an initial triangulation (typically two triangles for a rectangular grid) and iterates until reaching some termination criterion. During each iteration, the vertex of highest error is selected and inserted into the triangulation.

The error at a point (x,y) is defined as $E(x,y) = m(x,y)\Sigma_{i=1}^{d} w_i|\triangle_i|$ where $\triangle = f_S(x,y) - f_V(x,y)$. Using the weight vector w, the user can control the relative importance of the various channels of the height field. The *importance mask* $m(x,y)$ allows the user to selectively alter the importance of points by their position.

Our incremental triangulator uses edge flipping operations to perform local optimization on the triangulation after a vertex is inserted. This framework allows use of a wide range of optimality criteria. For instance, the empty circumcircle criterion will produce the Delaunay triangulation that has "well-shaped" triangles in 2D. Alternatively, we can use data-dependent criteria that try to improve the fit of the triangulated surface in 3D.

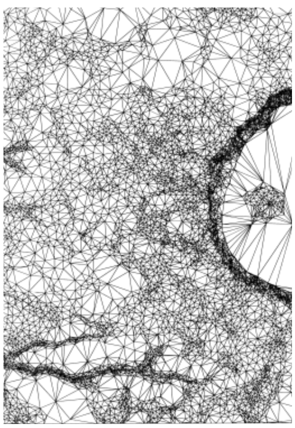


Figure 1 Sample mesh generated for Crater Lake terrain data (336 x 459 elevation grid). The mesh contains 7711 vertices (5% of the original).

Applicability to generalized height fields, selective weighting, importance masks, and a general triangulator all make this algorithm very flexible. Because the algorithm is a simple iterative refinement procedure, we also have the freedom to combine it with fairly arbitrary pre- and post-processing. For instance, we can pre-insert points or constrained edges into the initial triangulation, and we can perform least-squares fitting on the points in the final approximation to increase overall accuracy.

Though it is highly flexible, this algorithm can still be implemented very efficiently. We associate with each triangle in the approximation a candidate vertex that has the maximum error within that triangle. By maintaining these candidates in a heap, we efficiently track the vertex of highest error. And since the insertion of a vertex creates only local changes in the triangulation, we only need to recompute candidates in this local region.

Conclusion

We have outlined a simple algorithm for generating quality polygonal approximations of arbitrary height fields. The basic algorithm is very general and can accommodate a wide variety of extensions. It is also quite fast and can produce high quality approximations.

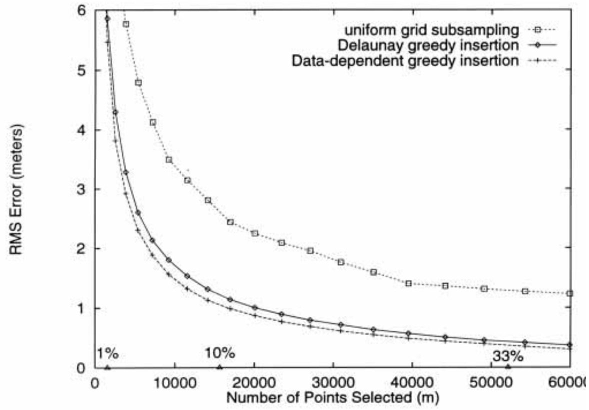
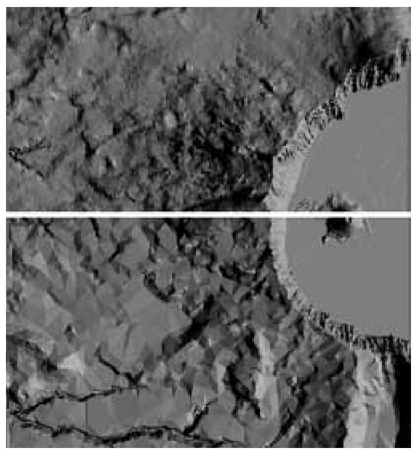


Figure 2 This demonstrates the RMS error of approximations of an actual terrain dataset as the meshes are iteratively refined. Three different approximation algorithms are shown: (1) sub-sampling on a rectangular uniform grid, and greedy insertion using (2) Delaunay and (3) data-dependent triangulation.

Figure 3
A portion of the Crater Lake surface. Above the white line is the surface reconstructed from the original terrain data. Below the line is the surface generated from the mesh in Figure 1.



We have implemented the algorithm outlined above, although it does not support all the extensions we have described. Our freely available public domain implementation, as well as our paper[1] giving complete details on the algorithm and references to related work , can be found at http://www.cs.cmu.edu/~garland/scape/

In our paper, we show that the expected running time of this algorithm to select m vertices from a regular grid of n samples is O((m+n) log m). This is significantly faster than the expected running time of O(mn) of the naive implementation that recomputes the error at every vertex on every iteration. As a concrete example, we can select one percent of the vertices of a 1024 x 1024 terrain in about 21 seconds on an SGI Indigo2.

References

1 Michael Garland and Paul S. Heckbert. Fast polygonal approximation of terrains and height fields. Technical report, CS Dept., Carnegie Mellon U., Sept. 1995. CMU-CS-95-181.

Contact MICHAEL GARLAND & PAUL S. HECKBERT
School of Computer Science Carnegie Mellon University 5000 Forbes Avenue
Pittsburgh, Pennsylvania 15213 USA garland@cs.cmu.edu

This paper presents a method for rendering Loop's subdivision surfaces[2] (with additions by Hoppe et al.[1]) that is fast, uses minimum memory, and is simple in structure. Our technique renders subdivision surfaces with several hundreds of control points at interactive rates on graphics workstations equipped with geometry engines (GEs).

In order to subdivide a control mesh of arbitrary topology, one needs to store not only the vertices of the control mesh, but also links for neighboring edges, faces, and vertices. A simple method for rendering Loop's subdivision surface would recursively create four new triangles for each existing one, update the vertex locations, and finally render the triangles at an application specified subdivision level.

We propose an alternative to the straightforward recursion that is amenable for implementation on dedicated GEs, where the resources are extremely limited. By doing this, we can render moderately complex subdivision surfaces fast enough to allow simple interactive modeling.

First, we need to partition the problem of rendering the full surface into small chunks that can be processed separately. There are several reasons for this: the subdivision surface model can be arbitrarily large, we want to take advantage of parallelism in case of several GEs, and GEs cannot in general run very complicated algorithms. Our approach is to subdivide the control triangles in pairs. Pairs are carved from the control mesh and sent (along with immediately neighboring vertices) to GEs for further processing. We use priority queues to chop off triangle pairs from the control mesh, avoiding leaving triangles without a unique mate.

In the GEs, we organize the triangle pair into a quadrangle and store the vertices into a square array (see Fig. 1). At each subdivision, we split the edges and add vertices. Each new vertex has exactly six neighbors.

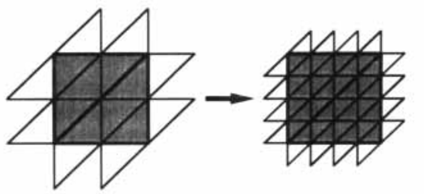


Figure 1 Compact vertex storage.

Simply subdividing the triangles one level at a time still uses memory on the order of the size of the output. A recursive depth-first approach could subdivide part of the array, render the triangles as soon as they have been calculated, and reuse the memory. It turns out that we need to store only a window of three rows of the 2D array for each level, plus two rows for the final vertex coordinates and normals. The following pseudocode and Fig. 2 illustrate this recursive algorithm. An actual implementation unrolls the recursion up to a prespecified maximum level (determined by how much memory is available) with conditional exits for doing fewer levels.

```
SUBDIVIDE(level, last)
BEGIN
  IF (level != last) THEN
    split horizontal edges and update vertices
    SUBDIVIDE(level+1, last)
    split vertical and diagonal edges
    SUBDIVIDE(level+1, last)
  ELSE
    calculate final positions and normals
    render triangle strip
  ENDIF
END
```

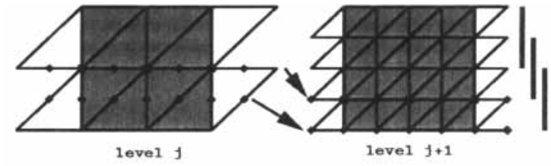


Figure 2 Calculating a new row at level *j* enables the calculation of two more rows at level *j*+1. Bars on the right depict the extent of the current window.

We implemented the algorithm as an experimental extension to OpenGL for the SGI Reality Engine (microcode inside GEs) and SGI Indigo 2 (host-level implementation). On both platforms, our implementation was faster than the OpenGL NURBS implementation.

model	control points	triangles	triangles/sec (1000s) RE	triangles/sec (1000s) Indigo
SUBDIVISION SURFACES				
teapot	157	4960	147	26
		19840	207	31
car part	126	3264	157	26
		13056	212	39
NURBS SURFACES				
teapot	512	8740	141	24
car part	1143+189	5608	80	22

Figure 3 Rendering timings.

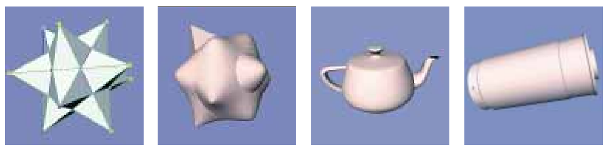


Figure 4 A control mesh with color codes for the vertex and edge types, and the surface. The images on the right show the surfaces used in timings.

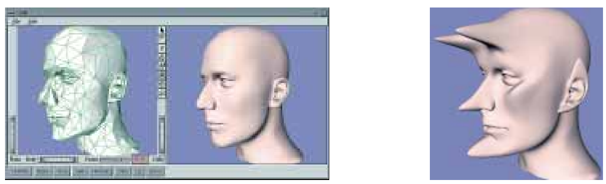


Figure 5. A control mesh of a head, the resulting subdivision surface, and the result after some minor edits.

For a full description of the algorithm and the techniques used to implement it, see[3].

References

1 H. Hoppe, T. DeRose, T. Duchamp, M. Halstead, H. Jin, J. McDonald, J. Schweitzer, and W. Stuetzle. Piecewise smooth surface reconstruction. Proceedings of SIGGRAPH 94. July, 1994

2 C. Loop. Smooth subdivision surfaces based on triangles. Master's thesis, Department of Mathematics, Univ. of Utah, 1987.

3 K. Pulli and M. Segal. Fast Rendering of Subdivision Surfaces. Proceedings of 7th Eurographics Workshop on Rendering. June, 1996

Contact

KARI PULLI
University of Washington

MARK SEGAL
Silicon Graphics, Inc.

A new algorithm to generate soft shadows is presented. It employs texture mapping and accumulation buffer hardware to produce shadows resulting from area light sources, in near real time.

Many shadow-generation algorithms have addressed the problem of quickly rendering the shadows that result from point light sources, as evidenced by the sharp, hard-edged outlines that are common in computer graphics. However, most shadows seen in real life have penumbras, the soft edges produced by extended light sources. We are introducing an algorithm that uses graphics workstation hardware to produce soft shadows quickly.

For each *receiver*, or object that has shadows cast onto it, we create a texture map to store the radiance at each point. A set of light samples (spread across the lights in the scene) is chosen to illuminate the receiver. For each light sample, we do the following. First, the receiver is shaded by illuminating it from this light sample. Then we project all objects between the light and the receiver onto the receiver. These are drawn in black, resulting in a hard-shadow image that represents the visibility for that view.

To produce a soft-shadow image from these hard-shadow images, their pixels must be registered. This can be done with a 4x4 perspective matrix that transforms a pyramid into a box. Notice that we do not want to "flatten" the objects to the plane of the receiver. Instead, we wish to have a 3D-to-3D transformation, so that we can easily clip away objects that fall behind the light source or beyond the receiver. The formula is available elsewhere.[1] The hard-shadow images are averaged using accumulation buffer hardware to produce a soft-shadow image.

For display, we can texture map the receiver polygons using our computed textures at the full speed of the graphics hardware. Additionally, shadows need to be recomputed only when objects move; camera motion is unlimited. Using OpenGL on an SGI Crimson with RealityEngine graphics, shadows for simple scenes can be computed in a fraction of a second. Figure 3 shows higher-quality shadows, produced in 13 seconds.

This technique for producing hard shadows has many advantages for interactive use and for applications where visual feedback is important. This algorithm is one of the first of its kind to produce soft shadows at interactive speeds. The hardware requirements are significant, but we hope that the ease with which it can be implemented and the wider availability of such hardware in the future will allow this algorithm to be used in many different settings.

Figure 1 Four projected hard shadows of a triangle onto a parallelogram receiver.

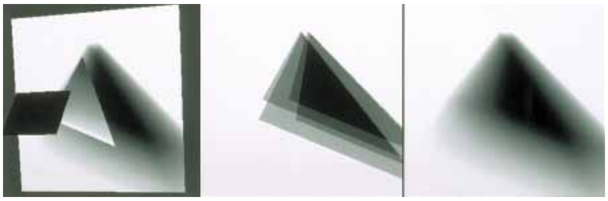


Figure 2 Center: combination of four shadows. Right: combination of many hard shadows. Left: projected onto the surface in the scene.

Figure 3 Soft shadows for 25 shadowed polygons illuminated by two light sources with 4-49 samples and 6788 occluders; textures generated in 13 seconds, redisplay at 30 Hz.

References

1 Paul S. Heckbert and Michael Herf. Simulating Soft Shadows With Graphics Hardware. Submitted for publication. See http://www.cs.cmu.edu/~ph.

Contact

MICHAEL HERF & PAUL S. HECKBERT

Computer Science Department
Carnegie Mellon University
Pittsburgh, Pennsylvania 15213
USA
herf+@cmu.edu
ph@cs.cmu.edu

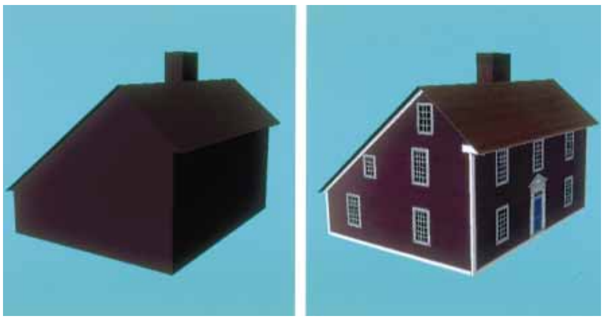
Hi-Lo Stereo Fusion

Hi-lo stereo fusion presents a fully rendered image to one eye and a reduced-resolution rendering to the other. When viewed, depth and details are fused into the percept.

Hi-Lo Stereo Fusion

We have developed a technique whereby stereo displays can be created or stored with a minimal increase in the computational resources required for single-image displays. Called hi-lo stereo fusion, these techniques present a fully rendered image of the scene to one eye and a reduced-resolution rendering of the scene to the other eye. When the two images are fused, depth is recovered from the stereo disparities available in the two images, and the details from the high-resolution image are fused into the percept such that the loss of resolution in the second image is not apparent.

Differential resolution displays can be of two sorts. First, both images can present surface boundaries; however, only one image presents surface texture. See the figure below.



The second application is depicted in the second figure. To the left is a complex high-resolution image and to the right is a stereo-appropriate rendering of the same object but at a much lower resolution. When the two images are fused, a three-dimensional object is seen based upon the disparities inherent in the low-resolution information. Moreover, the percept has a high-resolution appearance. These two techniques can be combined.

There are two reasons why differential-resolution stereo displays evoke high-resolution stereo depth percepts. First, the visual processes responsible for stereo-depth vision are driven primarily by low spatial frequency information corresponding to the low-resolution components in both images.[1] Second, binocular rivalry is not evoked by differences in the high-resolution information.[2] Instead, the high-resolution components of one image fuse onto the stereo-depth percept derived from the low-resolution components available in both images.

User Study

We conducted a user study that assessed the effect of viewing hi-lo stereo images on people's ability to fuse stereo images. Subjects played a computer game in which they shot a simulated cannon at targets displaced in depth. Number of hits was recorded over a 10-minute task period. Viewing was either biocular, hi-lo stereo, or normal hi-hi stereo. Prior to and after the task, subjects were assessed on their ability to fuse random-dot stereo images. As expected, the number of target hits was far greater for both stereo conditions relative to the biocular one. Surprisingly, subjects' performance on the stereo fusion task was improved in the hi-lo viewing condition relative to the hi-hi one. This finding indicates that hi-lo stereo viewing does not impair subsequent visual processing of normal stereo information.

Research supported by NASA Grant NCC2-925.

References

1 Tyler, C.W. Sensory processing of binocular disparity. In C. Schor & K. Ciuffreda (Eds.), Vergence eye movements. Butterworths, 1983.

2 Liu, L., Tyler, C.W., & Schor, C.M. Failure of rivalry at low contrast: Evidence of a suprathreshold binocular summation process. Vision Research, 32: 1471-1479, 1992.

Contact

DENNIS R. PROFFITT

Department of Psychology
Gilmer Hall
University of Virginia
Charlottesville, Virginia 22903 USA
drp@virginia.edu.

MARY KAISER
NASA Ames Research Center
Mountain View, California 94035 USA
moose@eos.arc.nasa.gov

Interacting with Virtual Gorillas: Investigating the Educational Use of Virtual Reality

To date, educational uses of virtual reality have focused mainly on improving task performance in adults, using application-specific hardware like flight simulators. We are building a virtual environment to provide knowledge instead of task training, targeted at students in grades K-12. Our chosen subject domain is gorilla behaviors and interactions.

Gorillas don't perform on cue. Because of the limited time school children can spend on field trips to the zoo to make observations, it is quite possible that they will never see certain classes of interactions. Also, because of the danger both to the children and the gorillas, all interactions must be observed third-hand, and it is impossible to provoke certain behaviors to test hypotheses about gorilla etiquette. We are building our system to determine if these problems can be effectively addressed using a virtual environment.

Our environment model is based on actual terrain data from the Zoo Atlanta gorilla habitat. It includes the trees and rocks that are visible from the central habitat in their correct positions, as well as a detailed model of the visitors' pavilion and the exterior of the night quarters. Gorillas are modeled using anthropometric data to accurately scale the various body parts. Motions are interpolated from a series of poses created by observing video footage or from written[1,2,3] and verbal descriptions of gorillas and their behaviors. Both motions and the gorilla models are being iteratively refined using feedback from the gorilla experts at Zoo Atlanta.

Looking downhill in Habitat 3 towards the visitor's pavilion.

Higher-level behaviors and interactions will be controlled by state machines that consider internal state, the external environment and actions of the other gorillas, and hierarchical position in the pecking order. In our initial system, the user interacts with the system by assuming the role of the juvenile gorilla in a family group consisting of an adult male silverback, an adult female, and the juvenile.

Audio is used to enhance the sense of immersion in the gorilla environment. Actual audio recordings of gorillas in various emotional states are associated with their corresponding behaviors and played synchronously when those behaviors are exhibited.

Gorillas lazing around in Habitat 3, enjoying the warm day.

A prototype of this system was tested in May 1996 at Zoo Atlanta with a group of middle-school children who had been observing gorilla behaviors from the viewing areas around the gorilla exhibit as part of an ongoing educational program at Zoo Atlanta. Their interactions begin in the visitors' pavilion and then progress out through the wall into the virtual gorilla yard, where they explore the central habitat and interact with the other gorillas. These students have been trained to accurately record gorilla behavior data at the zoo for subsequent analysis in their science classrooms. Their reactions should help us gauge the efficacy of learning by first-person interactions in a virtual environment as compared to third-person observations in the real world.

Beyond our initial implementation, we are planning to expand the system to allow users to visit the night quarters and to learn about zoo management, animal husbandry, and conservation, through experimentation and through annotations. We also want to take advantage of our accurate terrain models by adding the capability of doing zoo design, using virtual reality to investigate site lines, landscaping, and other design issues.

Partial support for this project was provided by Zoo Atlanta and the Edutech Institute. Special thanks to Terry Maple, Delora Forthman, Lori Perkins, Kyle Burks, and Kristen Lukas for their advice and guidance.

References

1 Diane Fossey, Gorillas in the Mist, Houghton Mifflin, 1983.

2 Terry L. Maple and Michael P. Hoff, Gorilla Behavior, Van Nostrand Reinhold, 1982.

3 George B. Schaller, Mountain Gorilla: Ecology and Behavior, University of Chicago Press, 1963.

Contact
DON ALLISON
BRIAN WILLS
LARRY F. HODGES
JEAN WINEMAN

Graphics, Visualization & Usability Center
Georgia Institute of Technology
don@cc.gatech.edu

Interactive Modelling of Branching Structures

We present a rule-based modelling system that allows the graphical interactive definition of botanical structures such as plants, including partial and global constraints and free-form deformations. The main idea is to represent the rule system by a structure tree with components of high functionality. In comparison to other rule-based approaches, complex branching structures can be developed faster and more flexibly.

The design of natural objects such as trees, bushes, or flowers is a challenging task in two respects. One is the enormous structural complexity, the other is the large amount of geometrical properties that must be managed.

Different approaches have been introduced to create plants. Among formal techniques, the most popular ones are textually edited grammars, known as L-systems.[2] Other specialized methods reduce the structural problem and concentrate on the generation of special objects such as trees.[3] In contrast to the rule-based generation and subsequent graphical interpretation of letters in classical L-systems, our rule system is defined interactively by a graphical metaphor. The software offers a set of predefined component types that play the role of letters in L-systems. Rules are created by combining components to a so-called structure tree.

Figure 1 Bush with corresponding structure tree.

In the structure tree of Figure 1, the camera component is the general root (the axiom). The component with the tree-like symbol produces a branch and defines the positions of subsequent leaves. The component related to the circular symbol multiplies its successors and creates in this example three branches. The double line indicates a recursion. The leaf component defines the geometry of the natural leaves. By double clicking on a component, the corresponding parameters are displayed and can be changed. Each component defines at minimum a transformation towards its predecessor, a geometric primitive and a maximum recursion depth.

Specialized components place objects on curves and splines, provide lists of cross-sections that are triangulated in a post process, or apply free-form deformations or constraints to subsequent parts of the generated geometric data. The effect of changing parameters is displayed immediately. Even complex structures (~100k triangles) are created and displayed on a SGI Indigo2 Extreme in less than five seconds. Higher display rates can be achieved by reducing the displayed complexity during modelling or by hiding of components, which is supported by the system.

Figure 2 a) A dandelion (150k triangles) with structure tree; b) a pine under influence of wind.

The dandelion of Figure 2(a) was created in two parts: the leaves are defined by splines and iterated around the stem (right part of the structure tree). The umbrellas are modelled by arranging hair on a rosette (lower three components of the left part). The head is done by placing umbrellas on a sphere according to the golden section.[1]

Generation of the geometric data according to the structure tree is done as follows: the camera object defines the view and creates the iterator object for the leaves. By this object, six leaf objects are created by rotating them around the origin. Also created by the camera is the stem. This object creates the iterator object, which for its part creates the umbrellas and so on.

By introducing global fields, environmental factors can be modelled. This includes gravitropism, phototropism, or the influence of wind. The pine of Figure 2(b) was built using a horizontal tropism towards the right.

The software is available as shareware. More information can be obtained at: http://www.greenworks.de

References:

1 R. V. Jean. Mathematical modelling in phyllotaxis: The state of the art. Mathematical Biosciences, 64:1-27, 1983.

2 P. Prusinkiewicz, A. Lindenmayer, and J. Hanan. Developmental models of herbaceous plants for computer imagery purposes. In J. Dill, editor, Computer Graphics (SIGGRAPH 88 Proceedings), Volume 22, Pages 141-150, August 1988.

3 J. Weber and J. Penn. Creation and rendering of realistic trees. In Computer Graphics (SIGGRAPH 95 Proceedings), Pages 119-128, August 1995.

Contact

BERND LINTERMANN
Institute for Dialog and Operating Systems
University of Karlsruhe
76128 Karlsruhe, GERMANY

OLIVER DEUSSEN
Institute for Simulation and Graphics
University of Magdeburg
39016 Magdeburg, GERMANY

An increasing amount of high-resolution visual information is being collected or generated from disparate sources such as satellites, radar, scientific research, and the arts. While there is a growing library of image manipulation tools, current browsing capabilities are limited to panning, zooming, and various types of insets or multiple-view approaches.

During the last few years many techniques have been developed for viewing discrete information detail in context.[3] Essentially, they allow magnification of chosen sections and compression of others. These techniques can increase the amount of information presented, retain the perception of the information space as a single event, increase user performance,[4] and follow common preferences for information presentation.[2]

In spite of all this positive evidence, there has been little extension of these techniques for use with raster or continuous images. This lack of extension may be because the distortion function is usually applied to discrete pieces of information. 3dps[1] is a multi-scale viewing tool initially developed for discrete information spaces but extensible to continuous spaces. The intention to create understandable distortion patterns while including or extending the functionality of other detail in context-viewing tools led to the basic concept of a 2D pliable surface. The actual information is placed on this surface, which is then manipulated in 3D space. In an analogous manner, complete images can be placed on this surface as a texture. Sections of the surface can be pulled toward the viewpoint to magnify them in perspective projection (Figure 1). Functionality includes multiple foci with arbitrary position and shape, distortion control, and visual cues.

Visual cues allow users to maintain an accurate mental representation. At present these cues include: shading, which gives an intuitive reading of form, and a grid, which gives an approximate quantitative reading (Figure 2). Notice that the additive application of shading preserves topological shading and that discerning focal points in the no-cues image is difficult (Figure 2 mid).

The current implementation (OpenGL's MIPMapping, SGI 's texture mapping) produces a highly interactive tool but ties image size to texture memory. We intend to combine this technique with multi-resolution storage. Other applications include image annotation, multi-resolution painting, and infinitely computable fractals.

Figure 1 B. C. top undistorted; mid 1 focus; bottom 3 foci.

Figure 2 Surface of Mars; 2 foci no cues; and 2 with cues.

Figure 3 Aerial photo of New Orleans with SIGGRAPH 96 logo inserted.

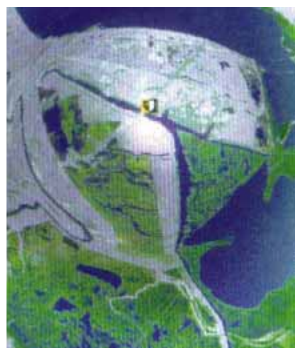


Figure 4 One focus reveals the SIGGRAPH 96 logo,

Acknowledgements

NSERC; the Algorithms Lab; Graphics and Multimedia Research Lab; the School of Computing Science, Simon Fraser University.

Initial images: Mars, Los Alamos National Laboratory; New Orleans, NASA/JPL; B.C., NAIS.

References

1 M. S. T. Carpendale, D. J. Cowperthwaite, F. D. Fracchia. In UIST'95, 217-226, 1995.

2 G. W. Furnas. Generalized Fisheye Views. In CHI'86, pages 16-23,1986.

3 E. G. Noik, A Space of Presentation Emphasis Techniques for Visualizing Graphs. In Graphics Interface'94, 225-233, 1994.

4 D. Schaffer, Z. Zuo, S. Greenberg, J. Dill, L. Bartram, S. Dubs, M. Roseman. Comparing fisheye and full-zoom techniques for navigation of hierarchically clustered networks. In Graphics Interface'93, 87-97, 1993.

Contact
M. SHEELAGH T. CARPENDALE
DAVID J. COWPERTHWAITE
F. DAVID FRACCHIA

School of Computing Science
Simon Fraser University
Burnaby, British Columbia V5A 1S6
CANADA
carpenda@cs.sfu.ca

In this sketch, I present a novel approach to model caustics through textures synthesized using a wave description of the propagation of light.

Subtle variations in intensity such as caustics can be simulated directly using optical simulations or can be faked using textures. I propose a method that lies somewhere in between. In general, it is easier to generate textures of surfaces than to generate textures of the illumination field reflected or refracted from such surfaces. Indeed, it is very difficult to fake moving caustics using standard texture synthesis tools. The basic idea behind my method is to construct a texture synthesis algorithm for the intensity field that is consistent with both the texture of the surface and the laws of optics.

This idea is not new in computer graphics and can be traced back to Blinn's bump maps. Ten years later, Krueger formalized this idea using statistical theories.[1] He modelled both the surface height and the intensity fluctuations as random functions. An alternative method to synthesize textures of caustics using a wave description of light was introduced to computer graphics 15years ago by Moravec, who unsuccessfully applied it to the global illumination problem.[2] His algorithm relies on the fact that the propagation of a planar light wave can be modelled by a series of convolutions. I will use precisely these filters that define the convolutions to synthesize textures of caustics.

The results presented in this sketch are partial. The method has to be improved and generalized in order to compete with the state of the art in caustics from water surfaces. However, I hope these results demonstrate that both the method proposed by Krueger and wave theory may have many more applications in computer graphics.

The Algorithm

The algorithm is given for an incident plane wave parallel to the random surface. At the surface, the phase of this wave is perturbed because points on the wave front traverse different distances in the water. The phase perturbation is therefore directly proportional to the surface height. After passing through the fluctuating region, the plane freely travels in the water medium. This part of the propagation can be described as a convolution of the wave with a filter derived from physical optics. This convolution is best performed in the Fourier domain. The filter depends on both the depth of propagation and the wavelength of the wave. In practice, following Moravec, the latter is taken to be twice the grid spacing used in the simulation. The algorithm is summarized as follows:

Generate random phase.
Transform resulting wave into Fourier domain.
Perform multiplication with the filter.
Inverse Fourier transform the result.

Animated textures are synthesized by generating a random phase correlated over time. If a spectral synthesis technique is used, then both the perturbation and the resulting caustics are periodic over time. This is highly desirable since even a small texture can produce an ever evolving caustic map. This is a very useful way of adding visual detail to the bottom of a pool, for example.

Results

I have computed several animations of caustics resulting from a random surface varying over time. Refer to Figure 1 for the results of computations of several images with different depth values. Notice how the effects of focusing become more pronounced as the depth is increased. This effect is illustrated in the picture in the bottom center of Figure 1. It's a vertical slice of the caustic maps computed at different depths. Pictures of underwater scenes similar to the state of the art can be produced by storing caustic textures for different depths in a three-dimensional table and volume rendering the result.

In Figure 2, I present some results that are similar to those accompanying Moravec's paper. The disturbing surface in this case is a smooth "bump" depicted on the right of Figure 2. Notice that spurious diffraction patterns appear even at small depth values. However, these effects do not show up as clearly for random surfaces. The diffraction effect is even more pronounced when a surface with a sharp discontinuity is used.

The results shown in this paper suggest that wave theory should be given a second chance in computer graphics. The main advantage of the wave method is that it does not suffer from aliasing. However, this problem is replaced by the problem of spurious diffractions (i.e., the interference patterns). To my knowledge, no one has yet researched ways of resolving this problem or given reasons why they cannot be resolved. Hybrid ray-wave methods may possibly provide a solution.

References

1 W. Krueger. Intensity Fluctuations and Natural Texturing. Proceedings of SIGGRAPH 88. pp. 213-220.

2 H. P. Moravec. 3-D Graphics and the Wave Theory. Proceedings of SIGGRAPH 81. pp. 289-296.

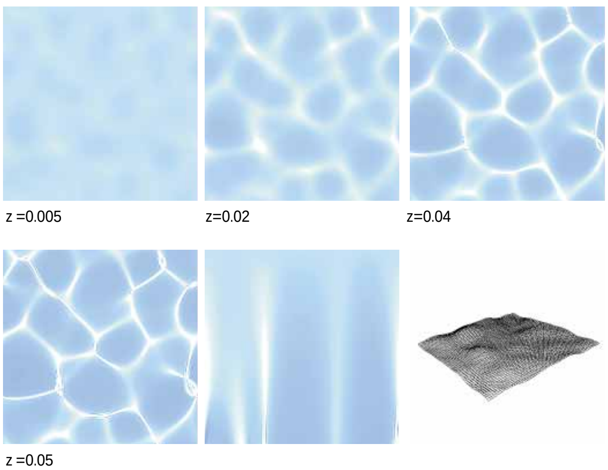


Figure 1 Simulations of caustics at different depths. The depth is given in meters below each picture. Notice how the caustic effects become more pronounced. The center bottom picture is a vertical slice demonstrating the focusing of light with depth.

Figure 2 Caustics from a smooth "bump" depicted on the right. The two pictures on the left show these caustics at different depths.

Contact JOS STAM

INRIA Rocquencourt BP 105 78153 Le Chesnay Cedex, FRANCE
Jos.Stam@inria.fr

VTT P.O. Box 1000 Vuorimiehentie 5 Expoo FIN-02044 VTT, FINLAND

We present a method, based on bounding-volume trees, for collision detection for objects moving within complex environments. Experiments show that our approach yields faster collision detection than previous methods.

Introduction
Real-time collision detection (CD) is of critical importance in interactive use of virtual environments, where haptic force-feedback can require on the order of 1000 intersection queries per second.

Previous Work
There is an abundance of previous work on CD, including methods based on octrees, k-d trees, BSP trees, sphere trees, bounding box hierarchies (both axis-aligned (e.g., R-trees) and oriented (e.g., strip trees, boxtrees, and OBB-trees), tetrahedral meshes, space-time bounds, and Voronoi diagrams.

Our Approach
Our approach is based on a carefully constructed hierarchical data structure. We combine our experience in bounding box hierarchies with ideas from the ray-tracing work of Kay and Kajiya (SIGGRAPH 86), to devise highly effective bounding volume hierarchies (BV-trees), and apply them to collision detection.

Our contributions include: (1) a careful study of effective methods of constructing BV-trees, using discrete orientation polytopes; (2) an efficient method for applying BV-trees of the static environment, and of each moving object, to detect collisions, even as the BV-trees of moving objects translate and rotate within the environment; and (3) extensive experimental results, with real and simulated data, to study the design issues of BV-trees that are most relevant to collision detection.

Our experimental results show how BV-trees can yield a dramatic speed-up over methods based on axis-aligned bounding boxes, while being computationally robust and readily applicable to highly complex, unstructured environments.

BV-Trees
In a BV-tree, each node is associated with a subset of the input primitive objects, together with a bounding volume that approximates this subset with a smallest containing instance of some specified class of shapes.

Here, we concentrate on our experience with BVs that are convex polytopes (Discrete Orientation Polytopes, or k-dops), whose facets are determined by planes whose normals come from a small fixed set of k orientations. Thus, axis-aligned bounding boxes are 6-dops, with orientation vectors along the positive and negative coordinate axes. A test for intersection between two k-dops is trivial (simple interval overlaps), and far simpler than checking for intersection between arbitrarily oriented bounding boxes, as in OBB-trees and boxtrees. Also, intersection tests using BV-trees are robust, and they easily handle cracks, (self-)intersections, or other defects of the input data.

In constructing effective BV-trees, a goal is to assign subsets of objects to the children of a node in such a way as to minimize some function (e.g., sum, max) of the sizes of the children (or of the union/intersection). We do an in-depth experimental comparison of various design choices, including: (1) degree (binary, ternary, etc.); (2) shapes of the dops; (3) splitting rules; and (4) top-down vs. bottom-up construction. In processing CD queries, we also consider choices of: (a) the depth of search before dropping to full-resolution checks, and (b) the order of checking among the orientations of the dops.

Another novel feature of our method is the "tumbling" of the BV-trees associated with moving objects, using simple "hill climbing" to update the axis-aligned BB, and using the B-reps of the k-dops at each node (precomputed using duality, and a convex hull code) to find a bounding k-dop at each frame, for each explored node of the BV-tree.

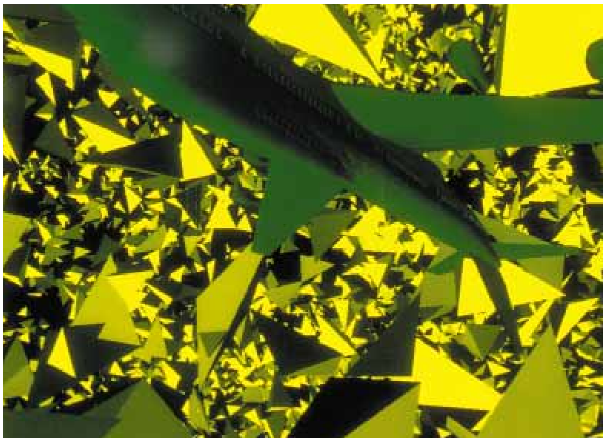
Experimental Results
We made an effort to devise datasets that were particularly difficult for our method (and others!). For instance, we considered "swept volume" datasets, in which a moving object is swept through space on a random motion, then obstacles are randomly placed close to, but not penetrating, the swept volume. Finally, we fly the object on the original path, so it just misses the obstacles.

The table gives input sizes (in # triangles) and time per collision test (in milliseconds) on four typical datasets: (1) Pipes: an interweaving pipeline flying among a larger copy of the same pipes; (2) Torus: a deformed torus flying among stalagmites; (3) 747: a Boeing 747 flying among 25,000 tetrahedra (shown in color plate); and (4) Swept: an "axis" flying through a swept volume through 10,000 tetrahedra. We ran our experiments on an SGI Indigo2 (150 MHz R4400, 160MB); times are exclusive of rendering and of motion simulation.

For comparison, on the Pipes and Torus datasets (albeit different flights), OBB-trees require (respectively) 4.2 ms and 6.9 ms per check, on a 90 MHz (512 MB) Reality Engine, versus our best times of 3.6 ms and 1.72 ms. On the Swept dataset (same flight), OBB-trees yield 1.7 ms on a 250 MHz (or 2.9 ms on a 125MHz), versus our 0.58 ms. (Data on OBB-trees and datasets 1 and 2 were provided by Gottschalk et al., SIGGRAPH 96) For more details, see http://www.cosy. sbg.ac.at/~held/publications.html

	Pipes	Torus	747	Swept
Env. Size	143,690	98,114	100,000	40,000
Object Size	143,690	20,000	14,646	36

Hier. Method				
BB	6.12	2.61	23.15	3.91
14-dop	4.12	1.75	9.98	1.28
18-dop	3.62	1.90	4.82	0.91
26-dop	4.09	1.72	5.97	0.58



Contact
MARTIN HELD, JAMES T. KLOSOWSKI & JOSEPH S.B. MITCHELL

SUNY Stony Brook, New York 11794 USA
[held,jklosow,jsbm]@ams.sunysb.edu

Since its inception, computer graphics has relied on the camera/film metaphor in the creation of computer-generated imagery. The goal of creating photorealistic renderings has led to major advancements in global illumination algorithms as well as development of complex camera models, which produce accurate and realistic camera effects.[1] Completion of this metaphor would require an accurate treatment of the effects of the recording medium. In the realm of photography, this would involve simulation of photographic film development and print processing.

In this sketch, we present the Virtual Darkroom (VDR), a system that simulates the photographic processing of black and white prints on computer-generated images. A goal of the system is to provide the same types of controls that are available to an actual photographer.

The Photographic Process

The response of photographic film and paper are a function of the size, number, and distribution of the grains within an emulsion. The science of measuring and determining this photographic response is called Sensitometry (for a good introduction, see[2,3]). Three sensitometric response curves are used to describe the characteristics of an emulsion: the Modulation Transfer Function (MTF), the Characteristic Curve, and the spectral response curve.

The MTF is a 1D linear filter that describes the resolving power of a given emulsion. It is derived from an emulsion's Point Spread Function, which gives the response due to a single ray of light at a given point. Although the MTF can give a good indication of an emulsion's response, its use is limited, since it incorrectly assumes that the formation and processing of a latent image is a linear process.

A more macroscopic view of an emulsion's response is given by its Characteristic Curve (H&D Curve). This curve shows the relationship between exposure and photographic density. The nonlinearity of the process is evident in this curve, although it usually contains a linear portion that is used in calculating the speed of a film or paper.

The spectral response curve gives the spectral sensitivity of an emulsion. Untreated, silver halite grains are only sensitive to violet and ultraviolet radiation. However, dyes are used to extend the spectral sensitivity to include different wavelengths of light. Sensitivities of popular black and white films include panchromatic (sensitive to all visible wavelengths), blue-sensitive, orthochromatic (sensitive to blue/green/violet light), and infrared.

System Overview

Our system is a post-processing step applied to rendered simulations. It is physically based: it expects simulated luminance values as input (such values can be outputted on a pixel-by-pixel basis by physically based renderers such as RADIANCE[4]). Renderers that provide only RGB values need to have pixel values carefully scaled to approximate the illumination of the scene.

Mimicking the actual photographic process, contrast control is specified by an H&D curve, grain resolution by an MTF, and color response by a spectral sensitivity curve. These data are representative of all emulsions and, fortunately, are generally available for most films and papers. This allows for accurate prediction of the effects of using particular photographic materials.

For exposure control, we supply a virtual exposure meter that provides representative camera settings for films based on their speed. This value can then be used in conjunction with Adams' Zone System[5] in determining the correct camera settings to produce the desired contrast control.

The photographic simulation is performed by first converting full spectral luminances to exposure using the spectral response curve and camera settings. Next, we filter the exposure values by the MTF and then pass the resultant values as input to the Characteristic Curve. This results in a photographic negative, which is used as an image template for the photographic print. The print is processed in a similar manner. (Details and assumptions of this model are described in[6].)

All of the computation is done in floating-point arithmetic, with the simulation producing a device-independent image of floating-point values. These values range between 0 and 1 and represent shades of gray on a linear scale corresponding to reflectance values off the paper base of the print. This image is further filtered and quantized based on the intended resolution, desired magnification, and characteristics of the output device.

Conclusions and Future Work

This system provides controls that are familiar in actual photography, and we expect it to be useful for interpretive-tone reproduction, and prediction/matching of the effects of actual films. We are currently in the process of validating the simulation model by comparing photographs of an actual scene with renderings of an equivalent virtual scene, post-processed with VDR. We are also working on modeling the effect of commonly used camera filters and more accurately modeling the enlargement process that takes us from negative to photographic print.

References

1 Craig Kolb, Don Mitchell, and Pat Hanrahan. A Realistic Camera Model for Computer Graphics. Computer Graphics (SIGGRAPH 95 Proceedings), pp 317-324, August 1995.

2 T.H. James and George C. Higgins. Fundamentals of Photographic Theory, Morgan & Morgan, 1968.

3 Todd, Hollis N. and Zakia, Richard D. Photographic Sensitometry: The Study of Tone Reproduction, Morgan and Morgan, 1969.

4 Gregory J. Ward. The RADIANCE Lighting Simulation and Rendering System. Computer Graphics (SIGGRAPH 94 Proceedings), pp 459-472, July 1994.

5 Ansel Adams. The Negative, New York Graphics Society, 1981.

6 J.C. Dainty and R. Shaw. Image Science: Principles, Analysis, and Evaluation of Photographic-type Imaging Processes, Academic Press, 1974, pp 232-241.

Contact

JOE GEIGEL
Pittsburgh Supercomputing Center
Pittsburgh, Pennsylvania 15213
USA
+1.412.268.3911
geigel@psc.edu

F. KENTON MUSGRAVE
The George Washington University
Ashburn, Virginia 22011 USA
musgrave@seas.gwu.edu

Stripe: A Software Tool For Efficient Triangle Strips

We outline the design of our software tool, Stripe, for constructing triangle strips from partially triangulated models and present experimental results showing that these strips are 10-30 percent better than those from previous best-known public-domain codes.

Introduction

The speed of rendering triangular meshes in computer graphics is limited by the rate at which triangulation data are sent to the graphics processor. Each triangle can be specified by three vertices, but to maximize the use of the available data bandwidth, it is desirable to order the triangles so that consecutive triangles share an edge. Using such an ordering, only the incremental change of one vertex per triangle need be specified. In this paper, we consider the problem of constructing good triangle strips from partially triangulated polygonal models. Our software tool, Stripe, exploits the freedom to triangulate polygonal faces in these models to produce superior strips.

To allow greater freedom in the creation of triangle strips, a "swap" command permits one to alter the FIFO queuing discipline in a triangle strip.[5] A swap command swaps the order of the two latest vertices in the buffer so that instead of vertex *i* replacing the vertex (*i*-2), vertex *i* replaces the vertex (*i*-1). Although the swap command is supported in the GL graphics library,[5] it is not supported in OpenGL[3,4] for portability reasons.[2] In this paper, we evaluate our software for the more realistic OpenGL cost model where every swap costs one vertex.

Constructing Triangle Strips

The best previous public-domain code for constructing triangle strips that we are aware of is from SGI[1] and works only on triangulated models. The SGI algorithm begins its construction of a triangle strip by starting from an arbitrary triangle with the lowest adjacency count, which is the number of triangles that share an edge with it, and extends the strip in both directions as far as possible without overlapping any previously constructed strips. The algorithm seeks to create triangle strips that tend to minimize leaving isolated triangles. There is no reluctance to generate swaps, and understandably so, since this algorithm was aimed at generating triangle strips for Iris GL.

We first partition the model into regions that have collections of quadrilaterals arranged in *m* rows and *n* columns, which we refer to as a patch. Each patch whose number of quadrilaterals, *mn*, is greater than a specified cutoff, is converted into one strip, at a cost of three swaps per turn. Further, every such strip is extended backward from the starting quadrilateral and forward from the ending quadrilateral of the patch to the extent possible. For extension, we use an algorithm similar to the SGI algorithm. However, we triangulate our faces "on the fly," which gives us more freedom in producing triangle strips.

Experimental Results and Conclusions

This approach to constructing triangle strips is the best out of 20 different heuristics that we have exhaustively tested on several datasets and is the one that we have selected as the method of choice in Stripe. Table 1 compares the results for Stripe versus the SGI algorithm.[1] The cost columns show the total number of vertices required to represent the dataset in a generalized triangle strip representation under the OpenGL cost model (where each swap costs one vertex). We can observe that our results are just 10 percent more than the theoretical lower bound of the number of triangles +2, so there is only limited potential for better algorithms.

As can be seen from the results of Table 1, under the OpenGL cost model, we are able to significantly outperform SGI's public-domain code. Although the SGI algorithm does have a slightly better running time, we do not believe this to be a serious drawback of our approach, since the triangle-strip generation phase is typically done offline before interactive visualization. Keeping this in mind, we have not yet done any serious performance tuning of our code, and there is some scope for further improving our run times.

A visual comparison of the triangle strips produced by Stripe versus the SGI algorithm appears in Figure 1, where every triangle strip is colored by a different color and constant shading is used. Our software is in public-domain and more information about its release is available at: http://www.cs.sunysb.edu/~evans.

Acknowledgements

We would like to acknowledge several valuable discussions we have had on triangle strips with Joe Mitchell, Martin Held, Estie Arkin, Jarek Rossignac, Josh Mittleman, and Jim Helman. The datasets that we have used are from Viewpoint DataLabs. Francine Evans is supported in part by a NSF Graduate Fellowship and a Northrop Grumman Fellowship. Steven Skiena is supported by ONR award 400x116yip01. Amitabh Varshney is supported in part by NSF Career Award CCR-9502239.

References

1 K. Akeley, P. Haeberli, and D. Burns. tomesh.c: C Program on SGI Developer's Toolbox CD, 1990.

2 J. Helman. Personal Communication.

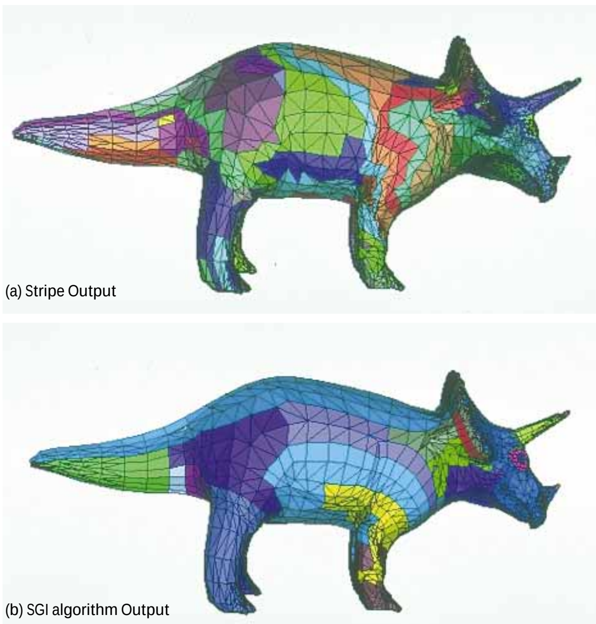
3 Open GL Architecture Review Board. OpenGL Reference Manual. Addison-Wesley Publishing Company, Reading, MA, 1993

4 Open GL Architecture Review Board, J. Neider, T. Davis, and M. Woo. OpenGL Programming Guide. Addison-Wesley Publishing Company, Reading, MA, 1993

5 Silicon Graphics, Inc. Graphics Library Programming Guide, 1991.

Data File	Verts	Tris	Cost SGI	Cost Stripe	% Savings
plane	1508	2992	4005	3388	15%
skyscraper	2022	3692	5621	4731	16%
triceratops	2832	5660	8267	5981	28%
power lines	4091	8966	12147	10266	15%
porsche	5247	10425	14227	11065	22%
honda	7106	13594	16599	14780	11%
bell ranger	7105	14168	19941	15011	25%
dodge	8477	16646	20561	17963	13%
general	11361	22262	31652	25912	18%

Table 1 Comparison of triangle strip algorithms.



(a) Stripe Output

(b) SGI algorithm Output

Figure 1 Comparison of triangle strip outputs

Contact FRANCINE EVANS, STEVEN SKIENA & AMITABH VARSHNEY
Department of Computer Science SUNY Stony Brook, New York 11794 USA
evans@cs.sunysb.edu

Traditional Cel Animation Look with 3D Renderers

This sketch shows a combination of rendering and image processing techniques that produce a cel animation look. All of the following work was completely developed by me with the exception of the trick edge detection and line masking methods, which I further developed from the work of Guy Williams, who is also affiliated with Warner Brothers Digital Studio.

At Warner Brothers Digital Studio, I have continued development of a traditional cel animation look with 3D renderers for "Marvin the Martian" in the 3rd Dimension project. It was necessary to model and animate the 2D characters and backgrounds in 3D in order to render stereoscopic images. Although we were animating in 3D, we were required to adhere to the classic Warner Brothers animation style that everybody is accustomed to seeing.

The first part to achieving this look is reducing the number of colors produced by the illumination model. Typically, cartoons are flat-shaded with the possibility of two or three levels of shading. This can easily be achieved by stepping from the dark color to the brighter color based on the Lambertian illumination model. More steps can be achieved by indexing into a color spline.

The second and more complicated part of achieving this look is simulating ink-drawn lines around and inside objects. Lines between objects can be obtained by rendering a separate channel with each object, or set of objects, constant rendered with different trick values. An edge detection done on this channel will produce consistent lines between objects. The edge-detection kernel I used simply sums up a Boolean equality check between the center pixel and the eight surrounding pixels, giving values within the range [0,8]. These values can then be scaled, negated, and multiplied back into the RGB channels.

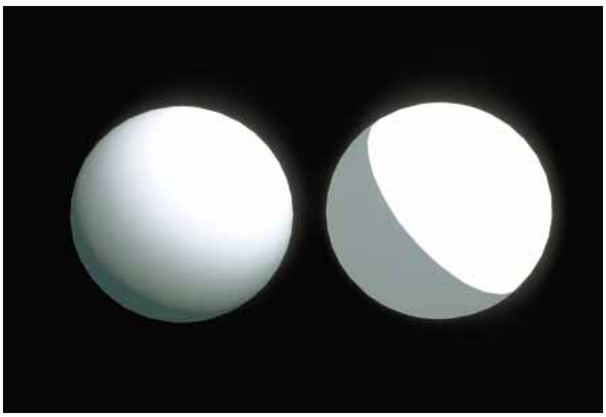
I achieved lines describing curvature by rendering out a normal channel, where each pixel holds the surface normal at that point. I ran an edge-detection kernel on this channel by summing up the angular distance between the center pixel and the surrounding eight pixels. Flat surfaces will produce a value of 0, while surfaces with higher degrees of curvature will produces higher values. After thresholding, this line can be combined with the trick line.

Some situations arise where certain lines or certain sections of lines are undesirable. In such cases, another one-bit channel can be rendered out, masking out the areas where undesirable lines occur. These areas can be texture mapped onto objects to erase lines around the map.

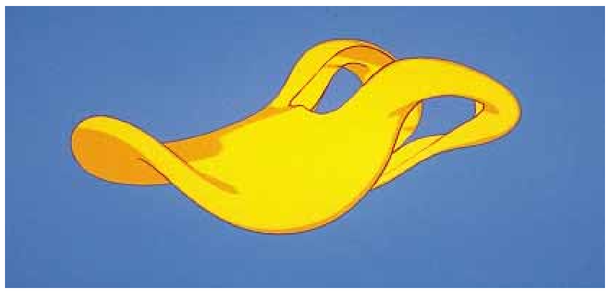
Colored lines can be created by rendering out another channel, where each object is constant shaded with an index value into a color look up table. Once the edge detections and masking are completed, each pixel on the line can be checked against the line color channel. If no edge is found at that pixel in the line color channel, the pixel in the line image is set to the color indexed by that value. This method allows lines internal to objects to be a different color than lines between objects. However, if a certain line color is required between objects, this can easily be done by setting both objects to the same line color.

Contact
Rev Lebaredian

Warner Brothers Digital Studio
+1.213.665.8151
revl@netcom.com



Toon Illumination



Edge Detection, normal channel

Example from "Marvin the Martian in the 3rd Demention"

Vision-Based Modeling for Production-Quality Integration of Photographic Imagery and 3D Graphics

Vision-based modeling of 3D scenes from filmed imagery represents the key technology in 3D geometry-based integration of imagery and 3D computer graphics. However, until recently, computer vision techniques have not been sufficiently reliable or precise to achieve production-quality modeling results. Thus, the film industry has continued to rely on 2D compositing techniques and, when the 3D paradigm is used, has relied almost exclusively on skilled production artists to manually model imaged scenes using their own visual skills.

In this sketch, we describe work in progress toward achieving automatic vision-based modeling that will live up to the demands of professional film production. We are currently using our system in the production of a motion-based theme park ride, which consists of an audience situated on a large platform ("motion base" or "simulator") that moves in synchrony with the film footage projected on a large dome. The coordinated movement and visual stimulus are intended to present a rich and extremely realistic sensory illusion.

In one scene of the ride, the desired illusion is of the audience being in a "Star Trek" shuttle craft flying through Las Vegas. For this scene, a helicopter-mounted camera was flown down the Las Vegas strip at 70 mph at altitudes ranging from 2 to 200 feet.

To produce the ride, the film imagery and motion base must have a coordinated motion, which is complicated by three important requirements: the imagery must be accelerated (since helicopters aren't nearly as fast as shuttles), large sudden motions must be removed for both audience comfort and dynamic limitations of the motion base, and yaw rotations must be removed because the platform does not yaw. Furthermore, 3D computer graphics must be added to the imagery to realize the other vehicles and explosions that are part of the ride.

These post-production goals present several challenges to the production studio. First, 3D locations of objects in the scene must be recovered to situate 3D computer graphics objects in the scene. Second, the 3D camera motion must be recovered to program the motion base. And third, the 3D motion of both the platform and the imagery must be altered in a coordinated way to meet the physical motion constraints of the ride.

We solve all of these problems using recent advances in computer vision that have been able to achieve the required production-quality accuracy. The system consists of the vision techniques in conjunction with a specialized feature-tracking tool and standard 3D computer graphics techniques.

First, a user identifies features in keyframes of each sequence. In one of our shots, the sequence is 1700 frames long (over one minute of film footage) and 35 keyframes are chosen (every 50th frame). In each keyframe, at least 10 features are identified (an absolute minimum of seven is required). The keyframes are used to predict feature locations in intermediate frames, and a template-based correlation method is used to accurately refine feature locations throughout all frames of the sequence in which they are present.

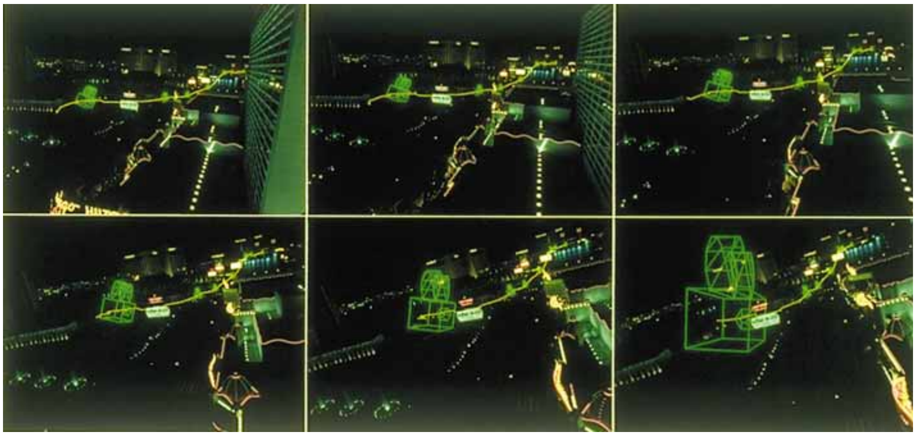
These feature tracks drive a 3D geometry estimator, described in detail in the reference, which yields 3D locations of the points and the 3D motion of the camera. The 3D points are used to obtain 3D geometric models of objects in the scene, achieving what is sometimes referred to as "3D rotoscoping," or registration of a 3D object in the scene so that its motion is consistent with the imagery. Locating real objects in the scene is often necessary for placing and occluding virtual objects correctly.

The recovered 3D motion is used to derive the smoothed camera motion for the motion base and to correspondingly alter the imagery. In general cases, one needs to know the entire 3D structure of the scene in order to properly alter the imagery in conjunction with an alteration of the 3D camera motion. However, if only the rotational motion is being altered, full scene structure is not required.

In our case, we need to remove yaw (rotation about a vertical axis), and we need to remove extreme accelerations in the imagery, which are due mostly to rotations of the mounted camera or rotation of the helicopter, not translations. We used the recovered rotation to obtain an acceptable smoothed trajectory and subsequently applied a 3D rotational transform to the imaged scene to stabilize it in a way that will be coordinated with the motion base of the ride.

References:

Ali Azarbayejani and Alex Pentland. Recursive estimation of motion, structure, and focal length. IEEE Trans. Pattern Analysis and Machine Intelligence, 17(6):562—575, June 1995.



Six closely spaced images from the start of a helicopter fly-through of Las Vegas. The green cameras represent a sampling of the recovered 3D camera stations along the yellow helicopter trajectory.

Contact

ALI AZARBAYEJANI
ALEX PENTLAND
MIT Media Laboratory
20 Ames Street
Cambridge, Massachusetts 02139
USA
ali@media.mit.edu
sandy@media.mit.edu

CHRIS PERRY
Rhythm & Hues Studios
5404 Jandy Place
Los Angeles, California 90066
USA
perry@rhythm.com
http://www.rhythm.com/~perry/publications/siggraph96.html

What are WebToons?

WebToons are imagemaps that use cartoons to summarize Web documents and link to corresponding text. WebToons feature people “talking” in word balloons. The user clicks on a word balloon and a link automatically brings up the indicated information.
Each WebToon frame represents one chapter; each word balloon represents one sub-topic.

The Problems
Documentation can be deadly dull. Information within Web documents can be hard to find.

Existing Solutions
Imagemaps provide a colorful, concise overview for Web documents. Scientific papers traditionally start with an abstract summarizing the paper.

What’s New About WebToons?
WebToons add the human element to imagemaps. Users relate to pictures of people. Word balloons are associated with cartoons, which are fun to read; the cartoon style makes the document more engaging. The balloons provide easy links to information. Existing imagemap technology is used in a new way.

How To Make a WebToon

- Write a very rough draft of a document and establish the main points. Sketch out cartoons with the main points in balloons.
- Rewrite the document, organizing it around the main points.
- Condense the cartoons into eight or fewer panels. Sketch a storyboard.
- Tighten up the document and storyboard.
- Digitally photograph or draw the panels in the storyboard.
- Use Photoshop 3.x to add layers to the images; put balloons and words on separate layers for easy revision. Convert to GIF, also saving layered image for later revision.
- Map the coordinates of the word balloons. Make each panel an imagemap and link them to the main text. Organize the imagemaps in a table.
- Get peer review. Install the WebToons and the document on the Web.

Contact
PAMELA P. WALATKA
MRJ at NASA Ames Research Center
Moffett Field, California 94035 USA
walatka@nas.nasa.gov
http://www.nas.nasa.gov/NAS/TechReports/NASreports/NAS-96-002

Computer Animation Festival

Computer Animation Festival

Welcome to the SIGGRAPH 96 Computer Animation Festival

For SIGGRAPH 96, the Festival received a record-breaking 515 submissions, representing over 25 countries in the fields of art, architecture, entertainment, technology, science, and education. Because SIGGRAPH attendees represent an ever-increasing variety of skills, interests, and backgrounds, this year's Computer Animation Festival features a number of animations that are educational and explanatory.

The 46 pieces selected by the jury for the Electronic Theater are shown at the historic Saenger Theater in New Orleans, where they can be viewed under the best conditions, including 35mm and 70mm motion picture projection, and high-quality video with surround-sound multi-channel audio.

Eighty-eight additional pieces can be seen in the Festival Screening Rooms at the Ernest N. Morial Convention Center. These works are shown in rotation several times a day throughout the conference in a relaxed environment, with related programs and events such as The Bridge: SIGGRAPH 96 Art Show, the Exhibition, and the Animator Sketches located close by.

We have also added a new event this year: a special Behind the Scenes session, in which the SIGGRAPH 96 Computer Animation Festival Committee reviews, explains, and answers questions about how material was chosen for the Festival Screening Rooms and the Electronic Theater.

SIGGRAPH 96 Computer Animation Festival Chair
LINDA BRANAGAN

Computer Amination Festival Committee

Screening Room Producer
GINA CONIGLIO
Ogilvy & Mather Direct

Technical Director
MICHAEL HARRIS

International Liason
HUGHETTE CHESNAIS

Publications
NANCY SMITH
Chromatic Research, Inc.

CD-ROM Production
WADE SMITH
Chromatic Research, Inc.

SIGGRAPH 96 Electronic Theater Open and Close

Contributors

Production
WINDLIGHT STUDIOS
702 North First Street
Minneapolis, Minnesota 55401 USA
+1.612.339.9091
+1.612.339.8991 fax

Storyboard Design
RON PITTS

Director
JOAN STAVELEY

Lighting & EFX Director
DAVID NOVAK

Technical Director/Procedural Animation
ERIC FLAHERTY

Producer
PAM LEHN

Technical Advisor
SCOTT DYER

Creative Advisor
DON BAJUS

Animators
JOAN STAVELEY
RON PITTS
MILTON RODRIGUEZ
EVAN OLSON

Models
ERIC FLAHERTY
ORIE HEGRE
JOAN STAVELEY

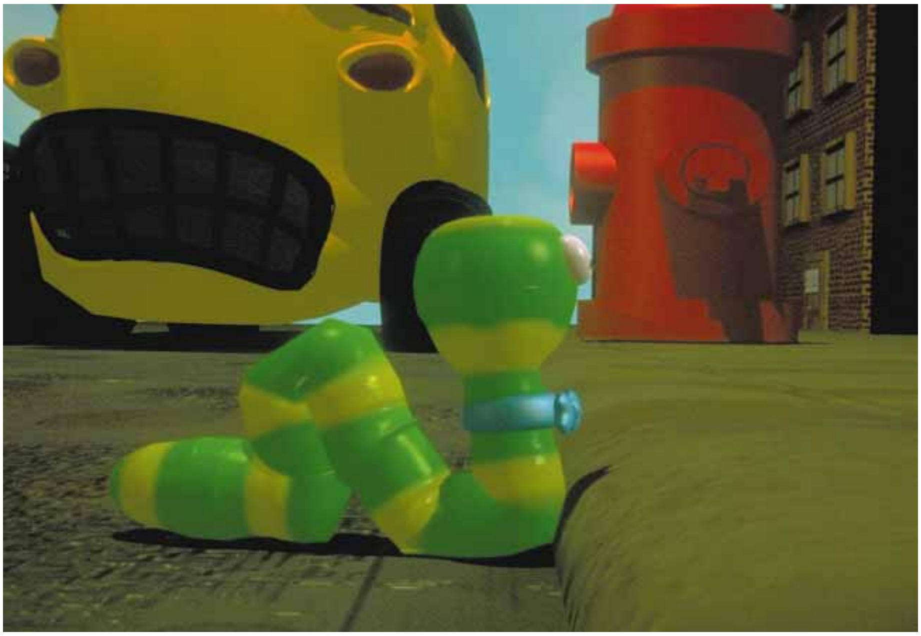
Research
KELLY MCMANUS
ALISON MORSE
JENNIFER STEPHENSON
AMY SANDERS
JEFF RAYMOND

Sound Design
JOHN PENNY

Hardware
SILICON GRAPHICS
ASCENSION FLOCK OF BIRDS

Software
ALIAS POWER ANIMATOR
WAVEFRONT COMPOSER
WINDLIGHT PROPRIETARY

Special Thanks
JOHN FUJII
LINDA BRANAGAN
TANYA ANGUITA
RICH SHELTON
ROB AITCHISON
ALIAS | WAVEFRONT
JIM BLINN
EVERYONE AT WINDLIGHT STUDIOS



A Worm's Life

The animation about a worm who tries to escape the dangers that approach him is symbolic of how one cannot outrun life's problems.

Contact
CHRISTINA KRAKOWIECKI

8119 Midnight Way
Tuscon, Arizona 85741 USA
chrissyk@viz.tamu.edu

Aftershocks

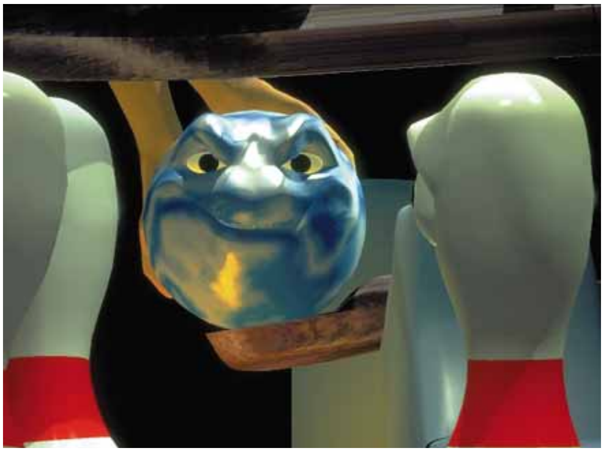
This video features special-effects scenes from the motion picture "Aftershocks."

Producer
TIPPETT STUDIOS

Visual Effects Supervisor
PHIL TIPPETT

Contact
PHIL TIPPETT

KC Rosenberg, Executive Asstistant
Tippett Studio
2741 Tenth Street
Berkeley, California 94710 USA
+1.510.649.9711
kc@tippett.com



Alley Oops!

Started as an exercise in character animation at UCLA Extension, this piece was brought to life by the students who stayed after class (for about three weeks) to see it through.

Producer/Director
ALLEN COULTER

Animators
RICH FUGEL, ALAN FLORES, TODD HOFF, DOUG WATERS

Music
AL SOUSA, LORAN SOMAN

Render Support
ED WIZELMAN, DAN PEREIRA, LILLIAN LIAM, TRACY KOBETT

Software
ANIMATION MASTER

Contact
ALLEN COULTER

Coulter Studios/UCLA Extension
209 North Niagara Street
Burbank, California 91505 USA
+1.818.846.9807
adcoulter@aol.com

Archway Cookies Talking Cow

Pacific Data Images provided lip-sync animation to create the illusion of a live cow talking. To achieve this effect, PDI replaced part of the cow's mouth with a CG lower jaw and morphed the upper lip to the dialogue track. PDI animators also digitally manipulated the cow's tail for emphasis.

Producer
LUCY T. GORMAN

Computer Animation
PACIFIC DATA IMAGES

Director
RAMAN HUI

Animators
TODD HEAPY, ERIC STRAND

Assistant Animators
NOEL MCGUINN, CURT STEWART

Editor
DAVE FENT

Agency
TRAVER ROHRBACK

Creatives
JOE KLIPPNER, TRACY ELLENBERG, BILL HAHN

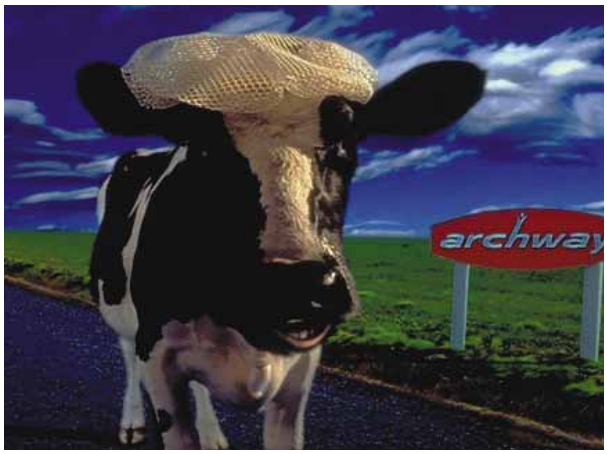
Production Company
GARY NOREN PRODUCTIONS, INC.

Director
GARY NOREN

Executive Producer
JUNE LEAHY

Line Producer
CHANTAL HOULE

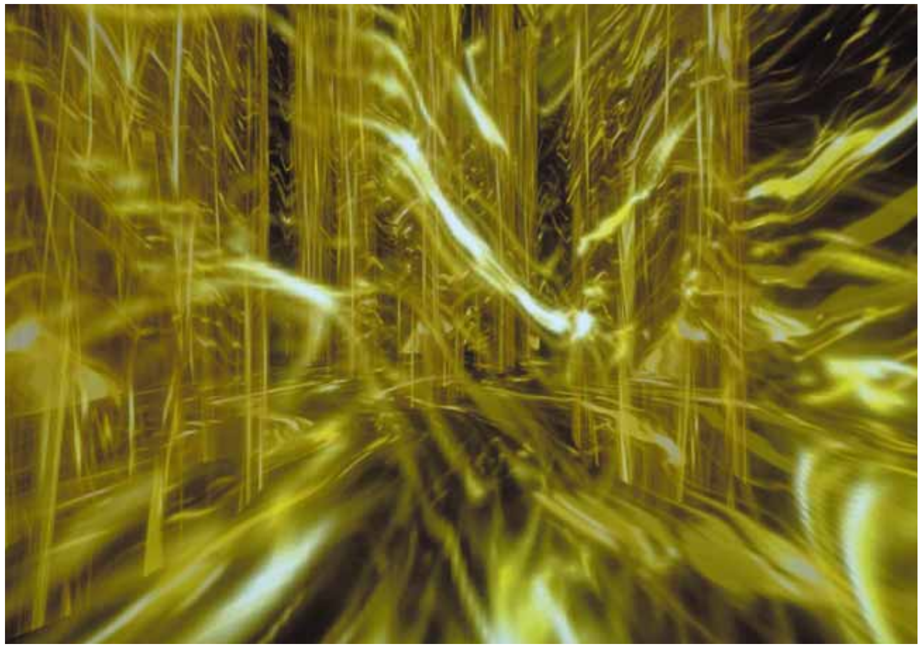
Editorial
BILL BRUNING/MARKHAM CO.



Contact
JUDY CONNER

Pacific Data Images
3101 Park Boulevard
Palo Alto, California 94306 USA
+1.415.846.8100
+1.415.846.8103 fax
jconner@pdi.com

Artica Intergalaxia



"Artica Intergalaxia" is an exhibition of real-time virtual reality art in an interactive, intergalactic gallery. The application explores the idea of art and galleries in virtual reality. It can currently be experienced in VR systems such as the CAVE and the Immersadesk at the University of Illinois at Chicago.

Producer
MARGARET WATSON

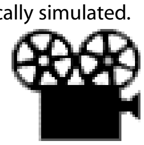
Contributor
JOE REITZER

Contact
MARGARET WATSON

Electronic Visualization Laboratory
c/o Tom DeFanti, EVL (M/C 154)
University of Illinois at Chicago
851 S. Morgan Street, Rm. 2032 ERF
Chicago, Illinois 60607 USA
+1.312.996.3002
+1.312.413.7585 fax
watson@evl.eecs.uic.edu

Atlanta in Motion

This video applies control algorithms to physically realistic models of humans to show computed motion of athletes as they run, dive, vault, bicycle, lift weights, and perform on the uneven bars and rings. The motion of the splash created by the diver and the sweatpants worn by the runner are also dynamically simulated.



Producer
JESSICA HODGINS

Dynamic Simulations
DAVID BROGAN, DAVID CARDOZE, REZA GHORIESHI, JESSICA HODGINS, EUN JAE LEE, RON METOYER, JAMES O'BRIEN, WAYNE WOOTEN, VICTOR ZORDAN

Models and Artistic Direction
DON ALLISON, ROBIN BAUMBERGER STEWART BRANN, DEBBIE CARLSON, DEREK DINTZNER, JEREMY HEINER, EUN JAE LEE, THOMAS MEYER, RON METOYER, JAMES O'BRIEN, REBECCA SPONGA, GUS WARTENBERG, WAYNE WOOTEN, VICTOR ZORDAN

Rendering Software
DON ALLISON, DEBBIE CARLSON, ELIZABETH DE GOURSAC, RON METOYER, THOMAS MEYER, JAMES O'BRIEN, MATTHEW PEASE, WAYNE WOOTEN

Original Score: "Impractical Jam"
JACK FREEMAN

Sound Effects and Foley
JACK FREEMAN, WAYNE WOOTEN

Special Thanks
CAD SYSTEMS DEPARTMENT AT THE ATLANTA COMMITTEE FOR THE OLYMPIC GAMES, RANDY CARPENTER, TERRY COUNTRYMEN, DAN FORSYTH, DAVID LEONARD, PETER WAN, THE MEDICAL INFORMATICS GROUP, THE SYSTEMS GROUP, AND THE GRAPHICS, VISUALIZATION AND USABILITY CENTER.

Contact
JESSICA HODGINS

College of Computing
Georgia Institute of Technology
801 Atlantic Drive
Atlanta, Georgia 30332 USA
+1.404.894.9763
+1.404.894.0673 fax
jkh@cc.gatech.edu

Contact
SUZANNE DATZ

Rhythm & Hues Studios
Advertising/Publicity Director
5404 Jandy Place
Los Angeles, CA 90066
(310) 448-7531 (tel)
(310) 448-7600 (fax)
suze@rhythm.com (email)

Babe: The Making of

The challenge for Rhythm & Hues Studios in "Babe" was to give animals realistic human emotions. we took the original photography and then used a sophisticated tracking process so that we could match the animal's movements to the dialogue, remove the origianl, live action animal's jaw, create the necessary facial animatoin and then do the final composite.

Animation & Visual Effects
RHYTHM & HUES STUDIOS

Visual Effects Supervisor
CHARLIE GIBSON

Visual Effects Producer
LIZ RALSTON

CG Supervisors
HAROLD BUCHMAN, TODD SHIFFLETT, LIZ KUPINSKI, EILEEN JENSEN

Animation Supervisors
SYLVIA WONG, NANCY KATO

Technical Directors
ED BATRES, GEORGIA CANO, CHARLES D'AUTREMONT, MARK HAMILTON, ALESSANDRO JACOMINI, RODIAN PAUL, JAY REDD, JEROME SOLOMON, ANDY SHENG, DAVID J. SMITH, HIROYUKI TAKAGAI, MICHAEL TIGAR, NICHOLAS TITMARSH

Modelling Manager
KEITH HUNTER

Modellers
NANCY KLIMLEY, TEX KADONAGA, DOUG IKELER

Digital Pant & Compositing
COLIN CAMPBELL, JOHN MCGEE, MEG FREEMAN, JUDITH BELL, CRAIG MULLINS

Digital/Optical Supervisor
BRUNO GEORGE

Film Recording
SUZANNE MCEACHRON, JULIUS YANG, DAVID KELLER

Software Development
TOSHI KATO, RICHARD MOSTER, PAUL ALLEN NEWELL, EUGENE VENDROVSKY

Production Manager
DAVID WEINBERG

Assistant Producers
LESLIE OLIVER, TAMARA NOBLES

Editorial
ROBERT YANO, JOSEPH YANUZZI

Post Production Assistant
BRENT YOUNG

Internet Bandits
JONAH MICHAUD, KAREN BRUNER

Tape Operators
KEN BARTLETT, KHOI DINH

Client
KENNEDY/MILLER PRODUCTIONS
DOUG MITCHELL - PRODUCER
GEORGE MILLER - PRODUCER
CHRIS NOONAN - DIRECTOR

better life

This animation is about the unselfish love of parents who sacrifice for the better life of their children.

Contact
TANGO IEZUMI

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34243 USA
+1.941.359.7574

Big Bear: Paper Bag Bear

This video brings a bear printed on a paper bag to life. Although Softimage provided the software for modeling, animating, and rendering the energetic and friendly bear, TOPIX developed its own method for animating the character with forward kinematics. This technique gives the bear more natural and flexible motion.

Contact
CHRISTINE FERGUSON

TOPIX Computer Graphics and Animation Inc.
567 Queen Street West, 3rd Floor
Toronto, Ontario M5V 2B6 CANADA
+1.416.504.5045
+1.416.504.2539 fax
chrisf@topix.com

Topix

Executive Producer
LISA WEINRIB

Director Animation/Live Action
FRANK FALCONE

Creative Director
HAROLD HARRIS

Director of Photography
ROY PIKE

Animators
FRANK FALCONE
KEITH HUGGINS
MARK SCHREIBER

Story Board Artist
BIRGITTA POLANNEN

Ron Foth Advertising

Producer
TED GORDON

Creative Director
RON FOTH JR.

Bloup

Producers
NAD CENTRE, FAUVE PROD.

Contact
J.F. WILLIAM

NAD Centre
3510 St. Laurent #202
Montréal, Québec H2X 2V2
CANADA
+1.514.288.3447
+1.514.288.5799 fax
jfw_nad@cam.org

Bio-Zoo

Producer
JULIEN DAJEZ

Design
JULIEN DAJEZ

Animation
JULIEN DAJEZ

Graphic Conception
JULIEN DAJEZ

Artistic Direction
JULIEN DAJEZ

Music
FRED LEONARD

Contact
JULIEN DAJEZ

16 bis rue Olivier Metra
75020 Paris, FRANCE
+33.1.48.43.90.08

(Body, Mind, Soul)

Created for the launch of Macromedia's 3D software, Extreme 3D, this animation depicts a fantasy tour of the body, mind, and soul of the software's mascot Fiona, a techno-retro-future-Renaissance woman.

Producer
IDEO

Contributors
PETER SPREENBERG, DENNIS POON, NEIL WILSON

Music
JUAN-CARLOS MENDIZABEL

Contact
PETER SPREENBERG

IDEO
Pier 28 Annex,
The Embarcadero
San Francisco, California 94105
USA
+1.415.778.4728
+1.415.778.4701 fax
spreenberg@ideo.com

Boxes

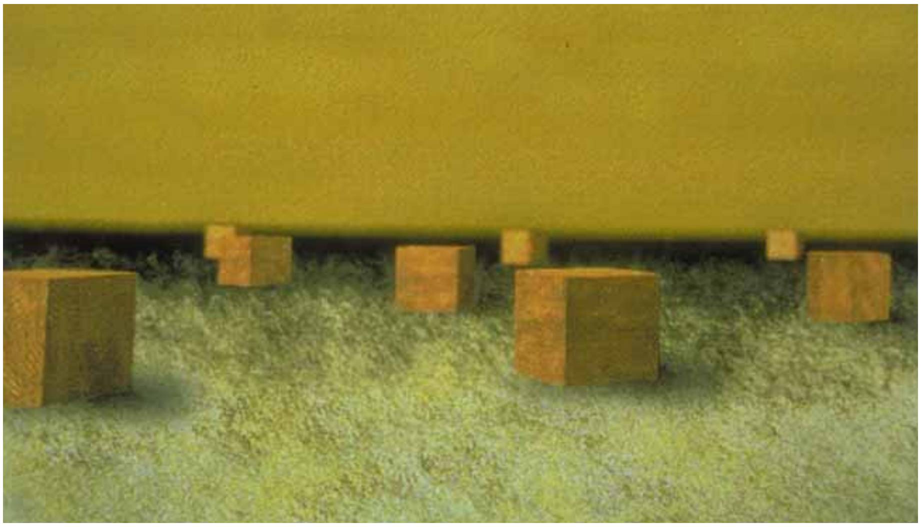
A lonely man seeks companionship.

Producer
GEORGE M. NADEAU

Music
SUE DOHERTY

Contact
GEORGE M. NADEAU

Rochester Institute of Technology
Student
301 Meigs Street #2
Rochester, New York 14607 USA
gmn4257@rit.edu



Inline

UNIX / External

Breath

The red and yellow M&M characters hold their breath in order to turn blue and be more like their hip blue counterpart. The attempted ruse fails when they finally exhale and return to their normal colors.

Producer
MARY SANDELL

Director
DAVID DANIELS

Executive Producer
DAVID ALTSCHUL

Technical Director
STEVE CARPENTER

Production Assistant
LORI KINGSTON

Storyboarding
ROBIN ATOR

Animation
STEVE BAILEY, MICHAEL O'DONNELL, JIM CLARK

Expression Animator
CHRIS OHLGREN

Lighting and Rendering
STEVE CARPENTER, KIRK KELLEY

Final Edit, Flint Composites, and Paintbox
MICHAEL COLEMAN

Camera Rotoscoping
KIRK KELLEY

Editor
SCOTT SUNDHOLM

Assistant Editor/Premiere Operator
GENO FOSTER

Lip Sync Logging
TOM SHEFT

Systems Administrators
OLIVIER GIFFARD

Archivist
LISA ROWAN

Live Action
COPPOS/THOMAS/SATO

Director
BRENT THOMAS

Director of Photography
KIRK BACHMAN

Line Producer
MICHAEL KING

Live Action Editorial
MAD RIVER, LA

Editor
LIVIO SANCHEZ

Producer
RENEE RAAB

Agency
BBD&O

Writer
GERRY GRAFF

Art Director
TIM SMITH

Associate Creative Director/Copywriter
SUSAN CREDLE

Associate Creative Director/Art Director
STEVE RUTTER

Producer
GARY DELEMEESTER

Account Executive
MICHAEL KEELER

Executive Creative Director
CHARLIE MEISMER

Chief Creative Officer
TED SANN

Music/Music Co
DAVID HOROWITZ MUSIC ASSOCIATES (NYC)

Sound Design
SCOTT SUNDHOLM (WILL VINTON STUDIOS)
ALBERT ENTERTAINMENT

Client
M&M/MARS

Brand Manager
MIKE TOWLKOWSKY

Contact
LISA ROWAN

Will Vinton Studios
1400 NW 22nd Avenue
Portland, Oregon 97210 USA
+1.503.225.1130
+1.503.226.3746 fax
lisa@vinton.com

Calderaland

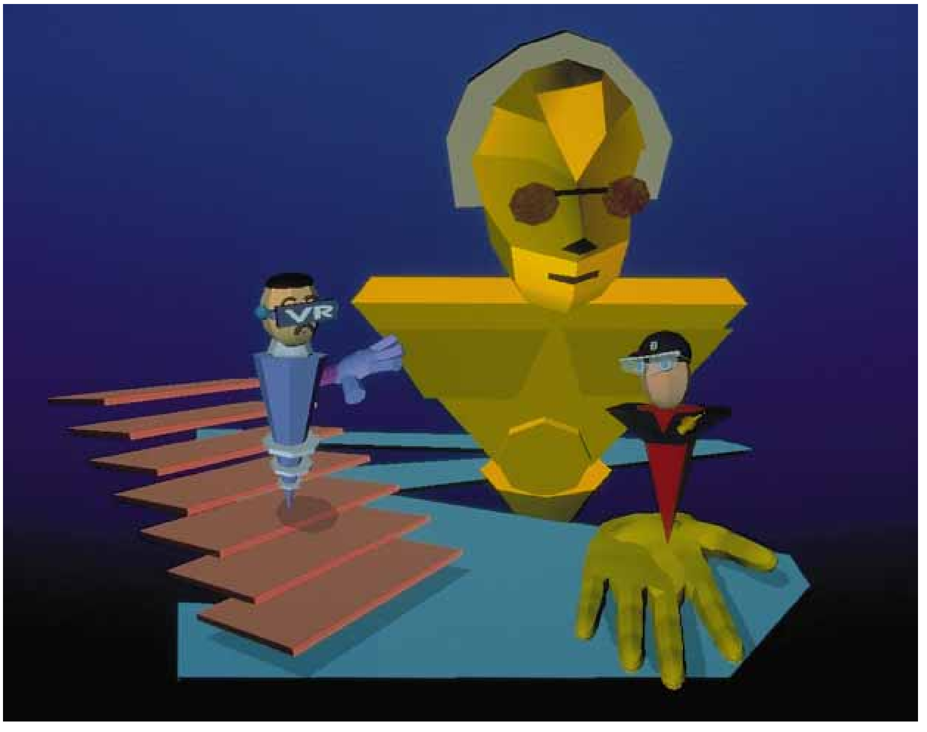
Calderaland" was created for public display in the Fiske Planetarium at the University of Colorado. The piece cautions the public, in an entertaining and educational way, about the frequent use of exaggeration in digitally rendered planetary landscapes.

Producer
COMPLEX SYSTEMS RESEARCH, INC.

Contributors
STEVEN M. WELCH, CARTER EMMART, STARLEY L. THOMPSON, PENELOPE J. BOSTON, TOM AND PAULA MUNCY, VICKI GENSON, GEOFF SKELTON, JAMES ADAMS

Contact
STEVEN M. WELCH

Complex Systems Research, Inc.
7097 Redwing Place
Longmont, Colorado 80503 USA
+1.303.530.2661
+1.303.581.9820 fax
smw@sage.cgd.ucar.edu



CALVIN: Collaborative Architectural Layout Via Immersive Navigation

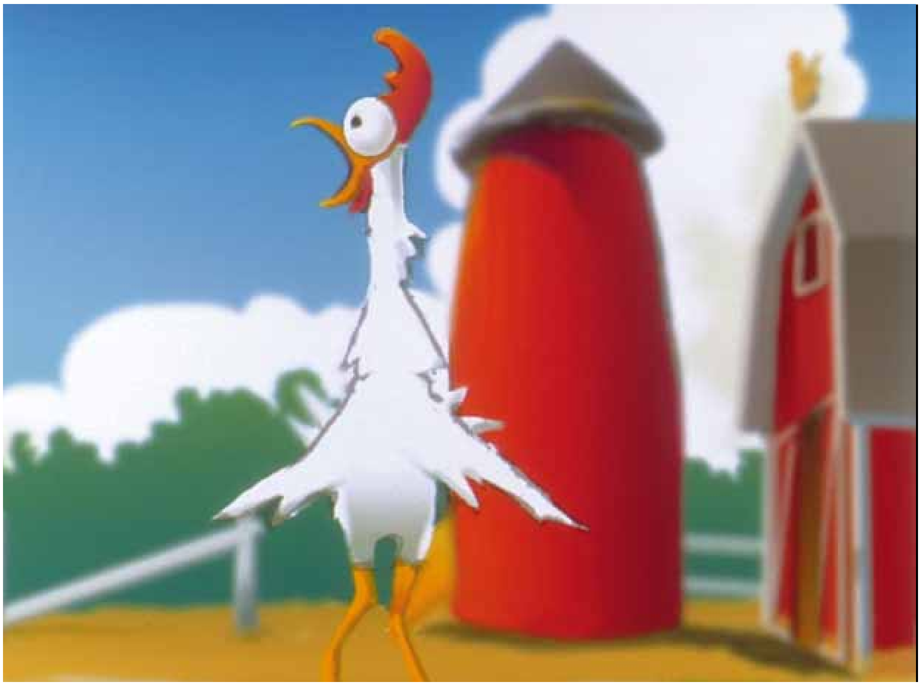
CALVIN demonstrates a unification of virtual reality, high-speed and high-bandwidth ATM networking technology, and novel user interfaces in the creation of a collaborative design environment. It allows multiple participants in transcontinental locations to share a common virtual environment that facilitates architectural layout.

Producer
JASON LEIGH

Contributors
JASON LEIGH, ANDREW E. JOHNSON, MICHAEL KELLEY, BRUCE GIBESON, STEVE GRINAVIC

Contact
JASON LEIGH

Electronic Visualization Lab
University of Illinois at Chicago, M/C 154
851 South Morgan Street
Chicago, Illinois 60607 USA
+1.312.996.3002
+1.312.413.7585 fax
jleigh@bert.eecs.uic.edu



Chicken Crossing

Chickens and roads – who knows what brings them together? As the chicken in this video game, you find out. You must cross the road, confront, and ultimately overcome all obstacles. The film demonstrates Talisman, a new architecture for real-time, low-cost multimedia on PCs.

Director and Producer
ANDREW GLASSNER

Concept and Technical Director
JED LENGYEL

Art Director
TOM MCCLURE

Technical Director
DEWEY REID

Chicken Animation
SCOTT BENZA

Sound Designer
TOM BETZ

Music Composed by
K. ALEX WILKINSON

Chicken Voice
TOM KEITH

Line Producer
STEVE DUBINSKY

Systems Integration and Modeling
MARK VAN LANGEVELD
John Deutscher Animation and Modeling

Talisman Crew Lead
LARRY OCKENE

Talisman Crew
CHRIS GEORGES, HOWARD GOOD, KENT GRIFFIN, JOHN SNYDER, BILL POWELL, MIKE TOELLE

Visual Effects
DAN COLVIN, JASON NAZARIO, JEFFERSON THOMAS

Special Thanks
PAUL ALEXANDER, REEVE BAILY, MATTHEW CLARK, TYLER DAVIS, QUINN EDAMURA, STEPHEN GARROW, JIM KAJIYA, RICH LAPPENBUSCH, DAN LING, RON MARTIN, PAUL OSBORNE, SANFORD PONDER, DAVID THIEL, JAY TORBORG

Contact
ANDREW GLASSNER

Microsoft Research
One Microsoft Way
Redmond, Washington 98052 USA
+1.206.703.0120
+1.206.936.0502 FAX
glassner@microsoft.com

Chocolate

An unusual worm discovers that the moon is not made of chocolate and flies his rocket ship back to earth to seek revenge upon the orbiting space monkey who deceived him.

Executive Producer
BRAD DE GRAF

Writer, Director, and Lead Animator
DAN HANNA

Producer
ANN BRILZ

Line Producer
EILEEN MCKEE

Voice of Fred
ERIK BERGMANN

Fred Models, Textures
BAY RAITT

Textures, Models
STEVE REIN

Title Animation
EMRE YILMAZ

Textures
KARINA JAKELSKI

Modeller
MARC SCAPARRO

Thanks to:
ERIC GREGORY, JAN MALLIS, AARON ALPAR, TOMMY ADAMS, KELLY KLEIDER, EVE LUNT, BRYAN KELLY, PHIL STEFFORA, RUSS GLASGOW, LARS JENSVOLD, MICHAEL STEIN, T. REID NORTON, GEVER TULLEY, JON MANDEL, TRACEY ROBERTS, and the rest of the crew at PROTOZOA.

Contact
EVE LUNT

Protozoa, Inc.
2800 Third Street
San Francisco, California 94107
USA
+1.415.642.4175
+1.415.824.0389
eve@protozoa.com

Cites Anterieures-Brugge (Excerpt)

Producer
MAURICE PROST, MIKROS IMAGE

Coproduction
MIKROS IMAGE, CANAL+, MAGIC COMPANY, GRAND CANAL

Scene Artist
CHRISTIAN BOUSTANI

Conception Graphics
ALAIN ESCALLE

Music
CECILE LE PRADO

Hardware
SILICON GRAPHICS, HENRY

Software
FLAME

Contact
MAURICE PROST

Mikros Image
7, rue Biscornet
75012 Paris, FRANCE
+33.1.44.752100
+33.1.44.752101 FAX

Computer-Generated Environments and Digital Matte Work for the Films "Casino" and "Dunston Checks In"

Matte World Digital wanted the ability to render realistic computer-generated environments that could be combined with live-action photography. Working with Lightscape Inc., we adapted Radiosity rendering for use in film work. This was the first time Radiosity has been used in a feature, for Martin Scorsese's "Casino," released in 1995.

Producer
CRAIG BARRON

Executive in Charge of Production
KRYSTYNA DEMKOWIC

Visual Effects Supervisor
CRAIG BARRON

Chief Digital Matte Artist
CHRIS EVANS

Digital Composite Supervisor
PAUL RIVERA

3D Architecture Rendering
MORGAN TROTTER

3D Element Rendering
CAMERON NOBLE

3D Modeling
BEN BARRON

Digital Matte Artist
CAROLEEN GREEN

Effects Editorial
MARTIN MATZINGER

Plate Photography
WADE CHILDRESS AND PATRICK LOUNGWAY

Camera Assistants
RICH MCKAY AND ANN LEE

Production Assistant
DOUG MARSHALL

Contact
CRAIG BARRON

Matte World Digital
24 Digital Drive #6
Novato, California 94901 USA
+1.415.382.1929
+1.415.382.1999 fax
cbarron@aol.com

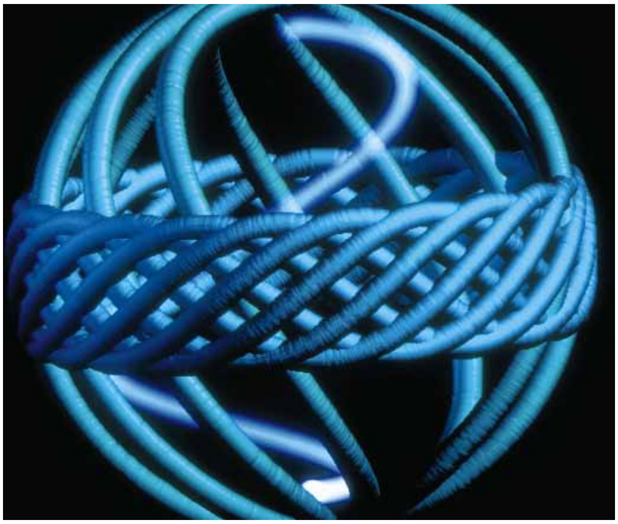
Convolve

"Convolve" is an exploration of complex spherical co-ordinate systems taken into a three-dimensional visualization program. The intent is to produce a visually stimulating sequence that any viewer can relate to as a string or rope that evolves and changes.

Producer
STEPHAN LARSON

Contact
STEPHAN LARSON

P.O. Box 288
University Station
Syracuse, New York 13210 USA
shlarson@mailbox.syr.edu



Cosmic Voyage: Galaxy Formation and Interaction

The IMAX film "Cosmic Voyage" is presented as a public service for the advancement of science education by the Motorola Foundation and the National Air and Space Museum, Smithsonian Institution, with additional support from the National Science Foundation.

Contact
DONNA COX

NCSA
605 East Springfield
Champaign, Illinois 61820 USA
+1.217.355.1387
cox@ncsa.uiuc.edu

Visualization & Design
DONNA COX AND ROBERT PATTERSON
NCSA

Visualization Software
ERIK WESSELAK
NCSA

Scientific Consultant
MICHAEL NORMAN
NCSA

Technical Assistant
BARRY SANDERS
NCSA

VR Software
MARCUS THIEBAUX
EVL University of Illinois at Chicago

Rendering Software

Senior Scientist
LOREN CARPENTER
Pixar

Senior Producer
SUSAN HAMANA
Pixar

Vice President
PAM KERWIN
Pixar

Executive Vice President & Chief Technical Officer
ED CATMULL
Pixar

Condensing Galaxy Simulation
FRANK SUMMERS
Princeton University

Colliding Galaxy Simulation
CHRIS MIHOS, LARS HERNQUIST
University of California at Santa Cruz

Director
BAYLEY SILLECK
Cosmic Voyage, Inc.

Producer
JEFFREY MARVIN
Cosmic Voyage, Inc.

Computational Resources
NATIONAL CENTER FOR SUPERCOMPUTING APPLICATIONS

SAN DIEGO SUPERCOMPUTER CENTER

PRINCETON UNIVERSITY

IMAX Film Recording
SANTA BARBARA STUDIOS

Acknowledgments
TOM DEFANTI
MEL SLATER
LARRY SMARR

Produced by
COSMIC VOYAGE, INC.

Crimson Tide

For the film "Crimson Tide," computer-generated torpedos, counter measures, and radio antennae were composited into elements shot in the Vista Vision film format. Motion-control data provided the animation for the virtual camera, and a dynamic simulation contributed to the realistic motion of the particles. In addition, submarine backgrounds were refracted through a particle renderer to simulate the propeller's wake.

Producer
DENNIS HOFFMAN

Contributors
ANJELICA CASILLAS, ROB BURTON, DAN DELEEUW, ROB DRESSEL, BLAINE KENNISON

Contact
MITCHELL DOBROWNER

Dream Quest Images
2635 Park Center Drive
Simi Valley, California 93065 USA
+1.805.581.2671
+1.805.527.7820 fax
mitch@dqimages.com

Cycles

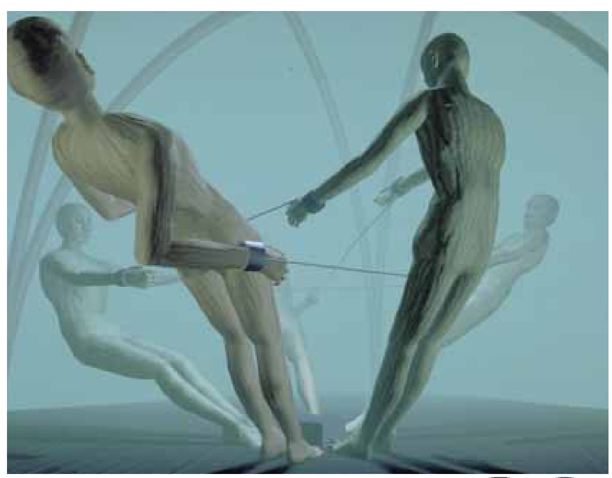
This collection of animation cycles is a metaphor for a range of inescapable interpersonal relations.

Producer
LISA SLATES

Music
JIM CULLEY

Contact
LISA SLATES

625 Rhode Island Street #5
San Francisco, California 94107
USA
+1.415.558.9267
lisa@xaos.com



Inline

UNIX / External

Different Themes

They do different themes, they do different themes at circle time. Trains and animals, dinosaurs. Oooh yeah." This video is the third in a series of digital collages based on true stories told through sampled voices and processed images. Some events were recreated for dramatic effect.

Producer
STUART SHARPE

Animation, Video, and Music
STUART SHARPE

Voices
SAMANTHA SHARPE AND NATASHA SHARPE

Hardware
MACINTOSH QUADRA 800

Software
ADOBE PREMIERE, ADOBE PHOTOSHOP

Inline

Contact
STUART SHARPE

42 Sunset Way
San Rafael, California 94901 USA
+1.415.256.9872
+1.415.256.9759 fax
sharpe@sirius.com

UNIX / External

Dreamaker

This video is an abstract representation of the artist's most vivid dreams. It depicts inner cosmic mystery, myth, fantasy, and surreal vision.

Producer
NICKSON FONG WEI MING

Animation
NICKSON FONG WEI MING

Sound Effects
NICKSON FONG WEI MING
JOHNIE HUGH HORN

Produced at
SAVANNAH COLLEGE OF ART AND DESIGN

Special Thanks
ELLEN LA FORGE, LUCILLA HOSHOR, MIKE NELSON, DANE SHEARS, MILES BELLAS, WING LAU, KWUN WAH CHUNG, COLIN TAN, ELIZABETH FONG, CHONG YONG, LUCY PETROVICH, JEAN IPPOLITO, SYBELLE BURY, CATH ROBBINS, JOYCE TSAI, BENJAMIN CHEUNG, JEROME LAM, GENE WEE, CHONG SIEW SIONG, YEE CHONG PENG, EDWARD KINNEY, PIERRE ARCHAMBAULT, GREG JOHNSON, DONA VALENTINE, WANYEE CHIA, SUAN CHING TAN, GUMPARNAT PASAGANON, BENJAMIN WONG, FONG KIM WONG

Hardware
SILICON GRAPHICS INDIGO

Software
SOFTIMAGE 3D AND PARTICLE SYSTEM, WAVEFRONT ADVANCED VISUALIZER, 3DESIGN AND COMPOSER

Contact
NICKSON FONG WEI MING

Savannah College of Art and Design
145 Fanon Street, Apartment D
Arcadia, California 91006 USA
+1.912.944.2289
buncheung@delphi.com

Dutch Nelson, Galaxy Guy

A middle-aged daydreamer finds himself accidentally pulled into an alternate universe where he is able to live out his fondest male fantasies.

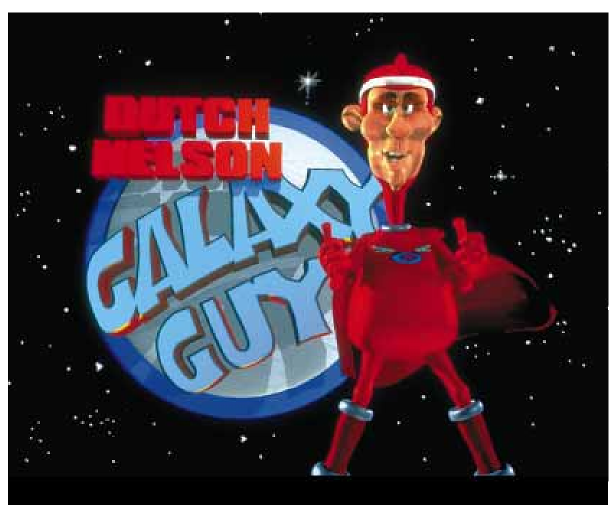
Producer
BRUCE PUKEMA

Contact
BRUCE PUKEMA

Ronin Animation
420 North 5th Street, Suite 708
Minneapolis, Minnesota 55401 USA
+1.612.672.0970
+1.612.672.0970 fax

Inline

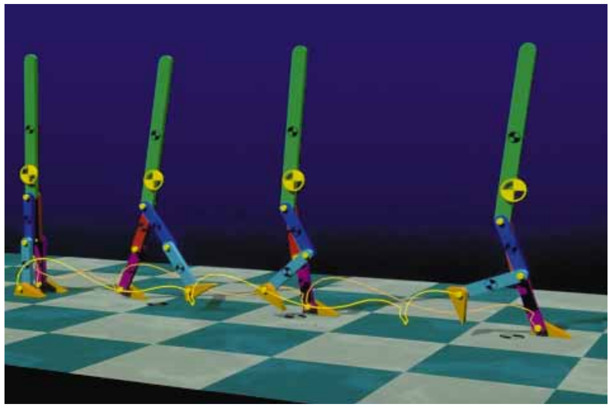
UNIX / External

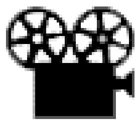


Dynamic Balance and Walking Control of Planar Bipeds

By using multibody dynamics and feedback control techniques, this video creates realistic motion for a planar seven-link biped model. The control system is designed to allow the biped to respond to various surface conditions and to reject disturbances. Interactive simulation software allows the user to operate the biped in real time.

Producer
JAMES J. TROY





Contact
JAMES J. TROY

Iowa State University
Mechanical Engineering
Department
2062 Black
Ames, Iowa 50011 USA
+1.515.294.6194
+1.515.294.5530 fax
troy@iastate.edu

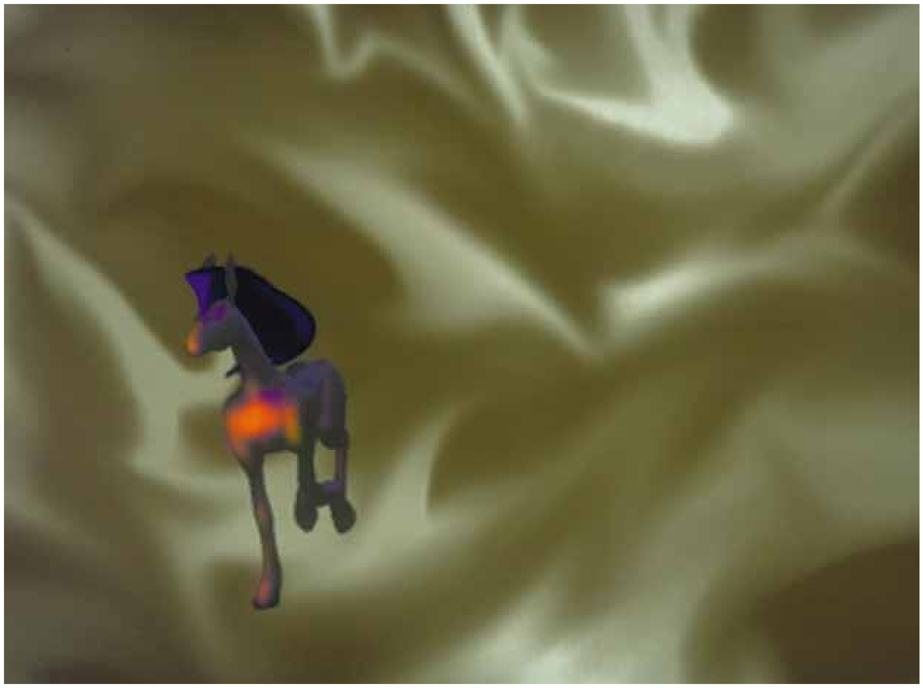
Echappee Belle (Breakaway)

Producer
ENSAD/AII

Contributor
VALERIE SALLES

Contact
PIERRE HENON

ENSAD /AII
31 rue d'Ulm
75005 Paris, FRANCE
+33.1.43.26.36.35
+33.1.40.46.81.54 fax
pierre@ensad.fr



Eclipse

"Eclipse" takes the computer form of 3D animation and integrates it with the traditional 2D frame-by-frame painting of secondary elements to give it a more stylized look and feel, emphasing the aesthetics of emotion through animation. The story itself is a metaphor of significant events that dissipate throughout life.

Producer
VIRGINIA C. SANTOS

Contributors
MFA COMPUTER ART DEPARTMENT, SCHOOL OF VISUAL ARTS

Contact
VIRGINIA C. SANTOS

School of Visual Arts
422 East 81st Street, Apt. 4D
New York, New York 10028 USA
+1.212.592.2538
+1.212.592.2509 fax
gini@sva.edu

Enigma Out from the Deep

Producer
JACOB KEIZER, ANZILOTTI & MUNZING PRODUCTIONS

Animation
A. ESCALLE, J.D. CHARRIERE, J.P. KEIZER

Art Direction
ANGEL

Music
ENIGMA

Contact
JACOB KEIZER

Anzilotti & Munzing Productions
Schielestr. 43
60314 Frankfurt, GERMANY
+49.69.42.08.40
+49.69.420.8415 fax

Envisioning Yuan Ming Yuan

The magnificent Yuan Ming Yuan was tragically burned in Beijing in 1860 during the first Opium War. Built by six generations of Qing Emperors and covering 350 hectares of land, Yuan Ming Yuan was once a museum, a playground, a library, and an art gallery.

Producers
DAVID BOTTA AND LIFENG WANG

Contributors
MAGIC LAB, UBC, ALIAS | WAVEFRONT, IBM CANADA, CENTRE FOR IMAGE AND SOUND RESEARCH

Contact
LIFENG WANG

Xing Xing Computer Graphics/MAGIC
University of British Columbia
2747 Melfa Court
Vancouver, British Columbia
V6T 1N3 CANADA
+1.604.822.6994
+1.604.822.5485 fax
wang@cs.ubc.ca

Esquisses

Esquisses" is an experiment in the use of particle systems as an evolution of painting into a dynamic form. The artist defined particles to act as live brush strokes, changing and interacting in sometimes unpredictable ways.

Contact
CHRISTINE Z. CHANG

55 rue Traversiere
75012 Paris, FRANCE
+33.1.43.07.10.60
100424.1646@compuserve.com

Producer
CHRISTINE Z. CHANG

Thanks to
ARSCIMED, PARIS

Fan-tasy

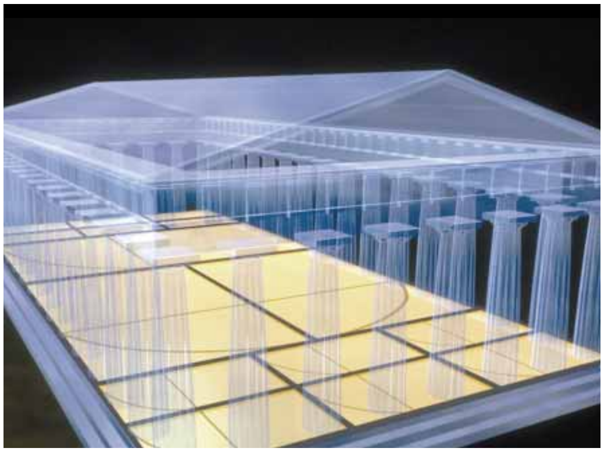
A helicopter inspires a desk-top fan to reach its full potential.

Producer
MAT MENEES

Contributor
MISSISSIPPI STATE UNIVERSITY
TELEVISION CENTER

Contact
MATT MENEES

Mississippi State University
145 Dove Lane
Salisbury, North Carolina 28147
USA
+1.704.636.2674
msm12@ra.msstate.edu



Inline

UNIX / External

Fibonacci and the Golden Mean

This piece uses illustrations ranging from contemporary studies in biology to ancient Greek architecture to describes how, in 1202 A.D., the Italian mathematician Fibonacci uncovered a mathematical link between science and art.

Producer
PALLADIN GROUP

Animation and Content Design
BEAU JANZEN

Narration
TINA HILL JANZEN

Editor
ESTHER REED

Acknowledgements
LINDSAY ROOT, STUART WOODWARD, DAVID W. FISHER, ANDREW REVAY, ROBERT FRONK

Studio Facilities
KLEISER-WALCZAK CONSTRUCTION COMPANY

Post-Production Facilities
BERGAMOT MEDIA

Online Editing Facilities
KET, THE KENTUCKY NETWORK

Contact
DAVID W. FISHER

The Palladian Group
P.O. Box 3468
Vero Beach, Florida 32964 USA
+1.407.231.9101
+1.407.231.9103 fax
dfisher@palladian.com

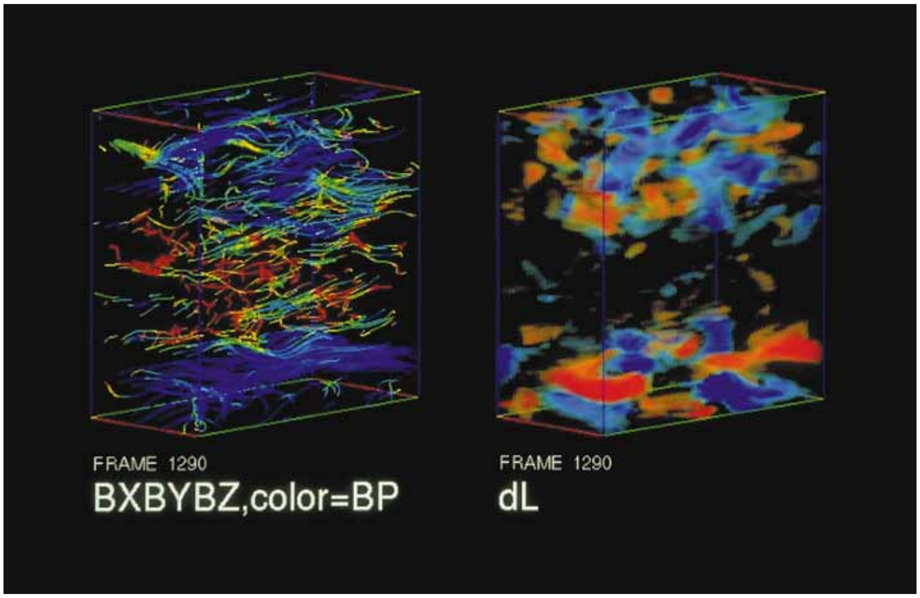
FMC Subsea GL/GLL Modular Cluster Manifold System

This animation shows the typical installation procedures for the FMC modular cluster manifold system. It was created using Lightwave 3D for modeling and animation and output to tape in real time using a DPS Perception Card.

Producer
MICHAEL STAFFORD

Contact
MICHAEL STAFFORD

Stafford Design Service
10630 Staghill
Houston, Texas 77064 USA
+1.713.897.0889
+1.713.897.0889 fax
73312.70@compuserve.com



Formation of Accretion Disks and Jets Around Black Holes

"Formation of Accretion Disks and Jets Around Black Holes" is an educational video including scientific data visualizations from accretion disk and jet simulations. The visualizations are introduced with an artist's impression of an accretion disk and narrated to provide insight into research on this topic.

Producer
JOEL WELLING

Graphics and Animation
GREGORY FOSS

Software Support
GRACE GIRAS

Video Support
ANJANA KAR

Narration
JOEL WELLING

Accretion Disk Researchers
JOHN F. HAWLEY
STEVEN A. BALBUS
University of Virginia

JAMES M. STONE
University of Maryland

3-D Jet Research and Animations
DAVID A. CLARKE
St. Mary's University

PHILIP HARDEE
University of Alabama

Contact
GREGORY FOSS & ANJANA KAR

Pittsburgh Supercomputing Center
4400 Fifth Avenue
Pittsburgh, Pennsylvania 15213
USA
+1.412.268.4960
+1.412.268.5832 fax
foss@psc.edu/ kar@psc.edu

Générique Officiel d'Imagina 96

Producer
INA-IMAGINA/MACGUFF LIGNE

Director
BERNARD DE AMORIN

Computer Graphics
MARTIAL VALLANCHON

Software
SYMBOR AND TRUCKOR, EXPORE, WAVEFRONT, FLAME, DIGITAL LOGIC

Hardware
SILICON GRAPHICS ONYX

Post-Production
BERNARD MAGAUD, INA

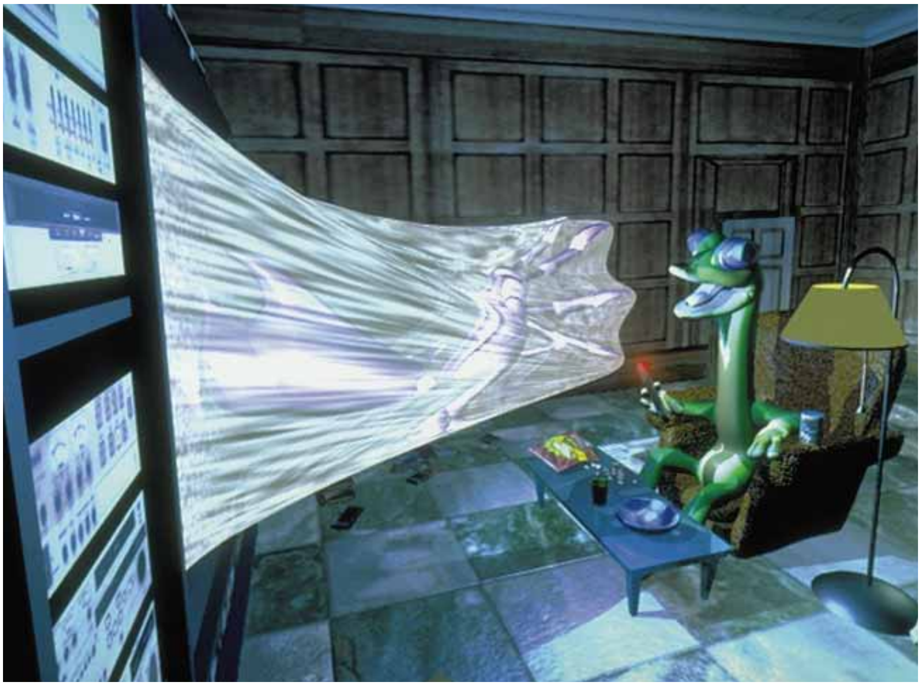
Sound Track
FRANCIS WARGNIER, FRANCISCO CAMINO

Contact
GILBERT DUTERTRE

INA-IMAGINA
4 avenue de l'Europe
94366 Brysur Marne, FRANCE
+33.1.4983.2562
+33.1.4983.3185
gilbert@imagina.ina.fr

Gex

This piece is an example of contrasting styles of motion-capture animation. Evil Rez is almost entirely animated with raw motion capture. The detail animation of the hands and cape were added. Gex, however, is heavily refined and exaggerated as he is violently snatched into the TV and spit out again. He needed to stretch, contort, and tumble in ways that were impossible for the motion talent to perform.



Producer
WINDLIGHT STUDIOS

Contributors
DON BAJUS, SCOTT DYER, DAWN DUERRE, JEFF FAUST, ERIC FLAHERTY, SHANNON GILLEY, ORIE HEGRE, ROBIN KAPLAN, PAM LEHN, KELLY MCMANUS, ALISON MORSE, DAVE NOVAK, EVAN OLSON, RON PITTS, JEFF RAYMOND, MILTON RODRIGUEZ, AMY SANDERS, JOAN STAVELEY, JENNIFER STEPHENSON

Video Game Animation
CRYSTAL DYNAMICS

Hardware
SILICON GRAPHICS, ASCENSION FLOCK OF BIRDS

Software
WINDLIGHT PROPRIETARY, ALIAS POWER ANIMATOR, AMAZON PAINT

Special Thanks to
CRYSTAL DYNAMICS, MIRA ROSS, LYLE HALL, STEVE KONGLSE, WEBTONE PRODUCTIONS, KATSIN/LOEB ADVERTISING, ALIAS | WAVEFRONT

Contact
PAM LEHN

Windlight Studios
702 North 1st Street
Minneapolis, Minnesota 55401
USA
+1.612.339.9091
+1.612.339.8991 fax
pam@windlight.com

Gitanes

Producer
JEAN-MICHEL FLEURY, KAMIKAZE

Contributors
TONY SMALL, HELEN GUETARY

Contact
LIONEL FAGES

Ex Machina
22 rue Hegesippe Moreau
75018 Paris, FRANCE
+33.1.44.90.11.90
+33.1.44.90.11.91 fax

Glacier Run

This motion simulation thrill ride is a white-knuckle experience of dazzling imagery, a non-stop action ride designed to make your senses erupt. It takes you to the freezing landscapes of the Arctic during the Northern Lights season.

Producer
BEN STASSEN
New Wave Entertainment

Director
SYLVAIN DELAINE

Production Designer
RAY SPENCER

Animators
ROLAND FRANCK, SERGE JANSSEN, OLIVIER VAN ZEVEREN

Contact
BEN STASSEN

New Wave Entertainment
308 Oudergemlaan
1040 Brussels, BELGIUM
+32.2.649.9406
+32.2.649.6988 fax

Golden Shoes

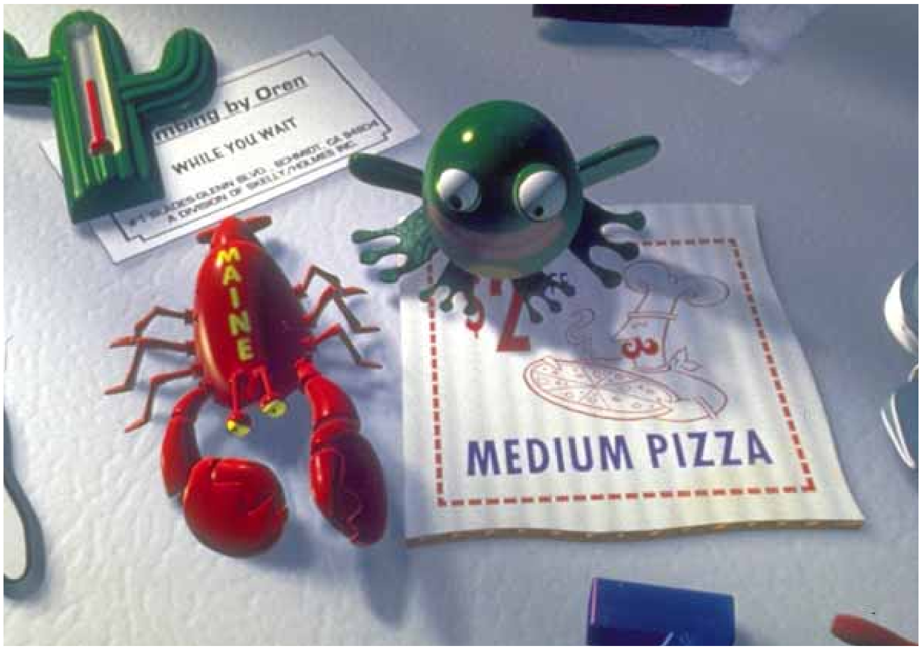
"Golden Shoes" is a dark photograph of a melancholy dream. Hazel is a girl who moves between two realms: her bleak rural life and a heavenly sphere of redemption and judgment. Likewise, the animation bridges opposite worlds: the handmade and the digital, illustration and cinema, two dimensions and three.

Producer
ADAM GRAVOIS

Artwork and Music
DAME DARCY

Contact
ADAM GRAVOIS

200 East 10th Street #491
New York, New York 10003 USA
+1.212.258.7574
agravois@aol.com



Inline

UNIX / External

Hallmark Magnet

Do refrigerator magnets really care what type of note they are holding? In this advertisement for Hallmark, the decorative magnets come to life after a Hallmark card is put on the refrigerator. The Scotty dog magnet holding the card shows his pride when he realizes where he is. The other magnets display their envy as they drop their own notes and converge on the Hallmark card. The Scotty dog tries to fend them off, but in the end, all of the magnets manage to find a place on the card.

Animation/Art Director
BOB PETERSON

Technical Director
OREN JACOB

Senior Producer
SUSAN HAMANA

Executive Creative Director
JOHN LASSETER

Executive Producer
DARLA K. ANDERSON

Production Manager
KORI RAE

Sound Effects
SKYWALKER SOUND

Music
MICHAEL BOYD MUSIC

Video Post
WESTERN IMAGES

Animation Director
BOB PETERSON

Technical Director
OREN JACOB

Animators
BOB PETERSON, ANDREW SCHMIDT, GLENN MCQUEEN

Technical Contributors
SHARON CALLAHAN, KEITH GORDON, MARK ADAMS, CYNTHIA DUELTGEN, SHALINI GOVIL, LAUREN ALPERT, DAVID LOMAX, DON SCHREITER, MITCH PRATER, MICHAEL FONG

Output
OREN JACOB AND MICHAEL FONG

Digital Painting
MARK HOLMES

Live-Action
PETER ELLIOTT PRODUCTIONS, CHICAGO

Agency
LEO BURNETT, CHICAGO

Agency Producer
CHRIS BRIG

Agency Creative Director
GREG BASHAW

Agency Art Director
STEVE BOUGDANOS

Agency Copywriter
STEVE ROMANENGHI

Client Representative
BRAD MOORE

Contact
JENNI TSOI

Pixar
1001 West Cutting Boulevard
Richmond, California 94804 USA
+1.510.412.6009
+1.510.236.0388 fax
jenni@pixar.com

Herbie Hancock – Dis Is Da Drum

"Dis is da Drum" is one of the few 3D CG music videos. Completed in five weeks, this three-minute video incorporates Alias, Wavefront, Prisms, and 3D Studio software as well as proprietary software, motion capture, and cyberscanning. A dancer's motion was recorded and applied in multiple 3D models using real-time motion capture.

Producers
CLINT GOLDMAN AND BERNICE KENTON

President
JAMES W. KRISTOFF

Executive Producer
DOBBIE G. SCHIFF

Senior Supervising Producer
JOHN FOLLMER

Director
MARK DIPPE

Senior Technical Director
JERRY WEIL

Lead Color & Lighting
THOMAS ROSENFELDT

Technical Directors
LARS FIELDS, NOBUHIRO MORITA, SUSAN OSLIN, CON PEDERSON, ALAN RIDENOUR, SUZANNE SMITH, SCOTT STOKDYK

Digital Art Directors
JUAN ROSENFELDT, JENNIFER LAW

Motion Capture Technicians
UMBERTO LAZZARI, FRANCESCO LAZZARI

Production Coordinator
DAN MCDONALD

Software Designer
SATY RAGHAVACHARY

Editorial
RON REYNOLDS

Client
MERCURY RECORDS

Contact
DOBBIE G. SCHIFF

Metrolight Studios, Inc.
5724 West 3rd Street, #400
Los Angeles, California 90036 USA
+1.213.932.0400
+1.213.932.8440 fax
dobbie@metrolight.com

Histoire De Crayon

Producer
PIERRE HENON

Scene Artist
MOIRA MARGUIN

Animation
MOIRA MARGUIN

Conception Graphics
MOIRA MARGUIN

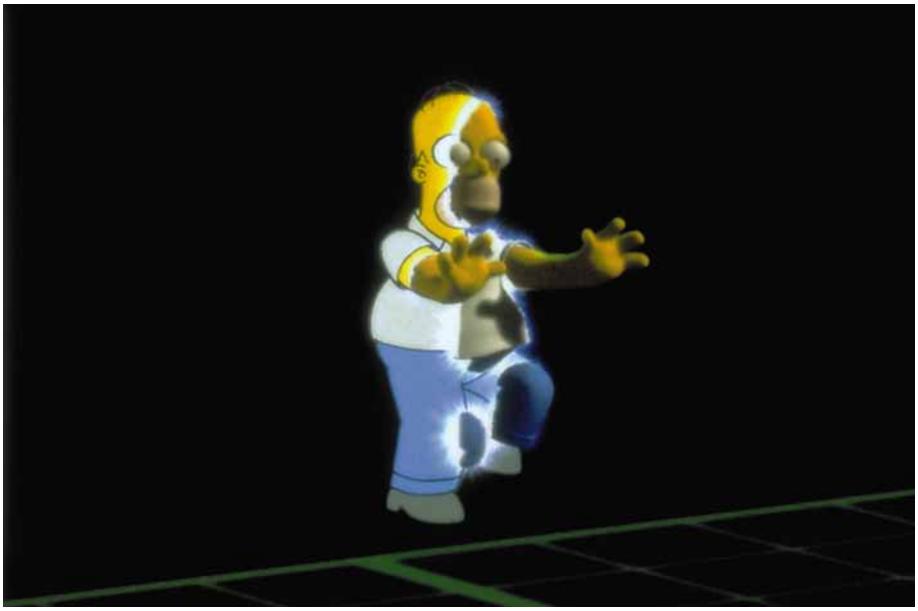
Music
MOIRA MARGUIN

Hardware
SILICON GRAPHICS

Software
EXPLORE

Contact
Pierre Henon

AII-ENSAD
31, rue d'Ulm
75005 Paris, FRANCE
+33.1.43.263635
+33.1.40.468154 fax
imagina@imagina.ina.fr



Homer^3: The Simpsons 1995 Halloween Special

Homer^3 represents the first traditional 2D character brought to life in 3D for television, and is replete with inside jokes that poke fun at the history of computer animation. Because of the realistic nature of 3D animation, PDI invented movements and gestures that did not exist for the cel animated characters and successfully animated facial gestures and lip-sync to convey the spirit of Homer and Bart.

Simpsons Producer
RICHARD RAYNIS

3D Computer Animation
PACIFIC DATA IMAGES, INC.

Executive Producers, Computer Animation
CARL ROSENDAHL, BRAD LEWIS

Computer Animation Directors
TIM JOHNSON, DENISE MINTER

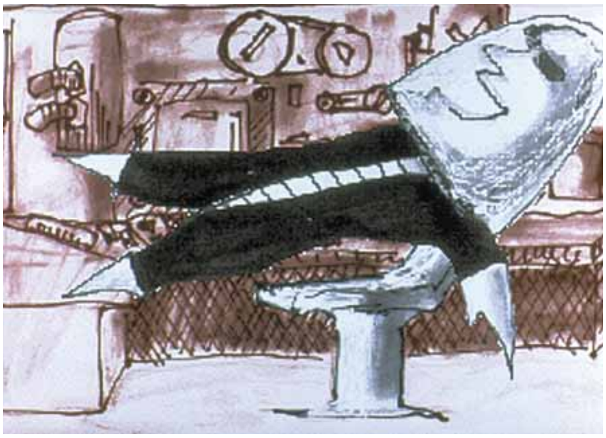
Head of Production
PATTY WOOTON

PDI Computer Animation Team Technical Directors
KEN BIELENBERG, BETH HOFER

PDI Computer Animation Team Members
MITCH AMINO, AL ARTHUR, KAREN SCHNEIDER-BRODINE, JEANNIE CUNNINGHAM, SEAN CURRAN, ERIC DARNELL, CHUNG CHAN, COLLIN HENNEN, LUCA PRASSO, KONRAD DUNTON, SHERRY HSIEH, DAVID RADER, DAVID FENT, NOEL MCGINN, JANET RENTEL, PHILIPPE GLUCKMAN, FRED NILSSON, CRAIG RING, RAMAN HUI, JOE PALRANG, BILL ROGINA, TODD HEAPY, CECILE PICARD, ERIC STRAND, PAUL WANG

Contact
JUDY CONNER

Pacific Data Images, Inc.
3101 Park Boulevard
Palo Alto, California 94306 USA
+1.415.846.8100
+1.415.846.8103 fax
jconner@pdi.com



How Does Drinking Affect Driving?

An illustration of the terrible results of drinking and driving, using examples of the stone sculptures on Easter Island, which the artist imagined to be aliens who suffered from the same side effects of alcohol.

Producer
CHOW CHIN PANG, PAUL

Contact
CATHERINE HU

School of Design
Hong Kong Polytechnic University
Hung Hom
Kowloon, HONG KONG
+852.2766.5493
+852.2774.5067 fax
sdcathu@polyu.edu.hk

Huzzah (Bobaloo The Beast Boy)

"Huzzah (Bobaloo The Beast Boy)" is an experiment in combining theater and computer graphics. The actor's performance was simultaneously captured using magnetic motion sensors on the body, optical sensors on the face, and stres sensors on the hand. The data were then passed to computer animators who created the final images.

Producer
LAMB & COMPANY

ADAPTED FROM LLOYD'S PRAYER, A PLAY WRITTEN AND PERFORMED BY KEVIN KLING

Director
LARRY LAMB

Project Supervisor
SUSAN VAN BAERLE

Character and Set Design
MICHAEL SOMMERS

Producer
AUDREY ROBINSON

Production
KEITH CORMIER, JIM RUSSELL, MARK MARIUTTO

Software/Hardware
JEFF THINGVOLD, SCOTT GAFF

Additonal Production Support
REX CARTER, CHRIS IMMROTH, JOHN DONKIN, TERRY FRIEDLANDER

Music Composition and Performance
MICHAEL SOMMERS, KEVIN KLING

Music Recording Studio
HUDSON & FORRESTER

ADR
CINE SOUND 2

Special Thanks to:
DAN ROUNDS

Executive Producer
LARRY LAMB

Contact
AUDREY ROBINSON

Lamb & Company
650 Third Avenue South,
17th Floor
Minneapolis, Minnesota 55402
USA
+1.612.333.8666
+1.612.333.9173 fax
audrey@lamb.com

Hydrodynamic Simulations of Star Formation

This simulation of a gas that collapses under the influence of its own gravitational field to form a compact spherical object shows a three-dimensional, volume-rendered representation of the gas mass density as it evolves in time.

Producer
ANDREA MALAGOLI

Contributor
CHAD KAINZ

Contact
CHAD KAINZ

University of Chicago
Multimedia & Visualization Center
Culver Hall
1025 East 57th Street
Chicago, Illinois 60637 USA
+1.312.702.9945
+1.312.702.3219 fax
c-kainz@chicago.edu

I Faust

Producer
STEVE HUNT

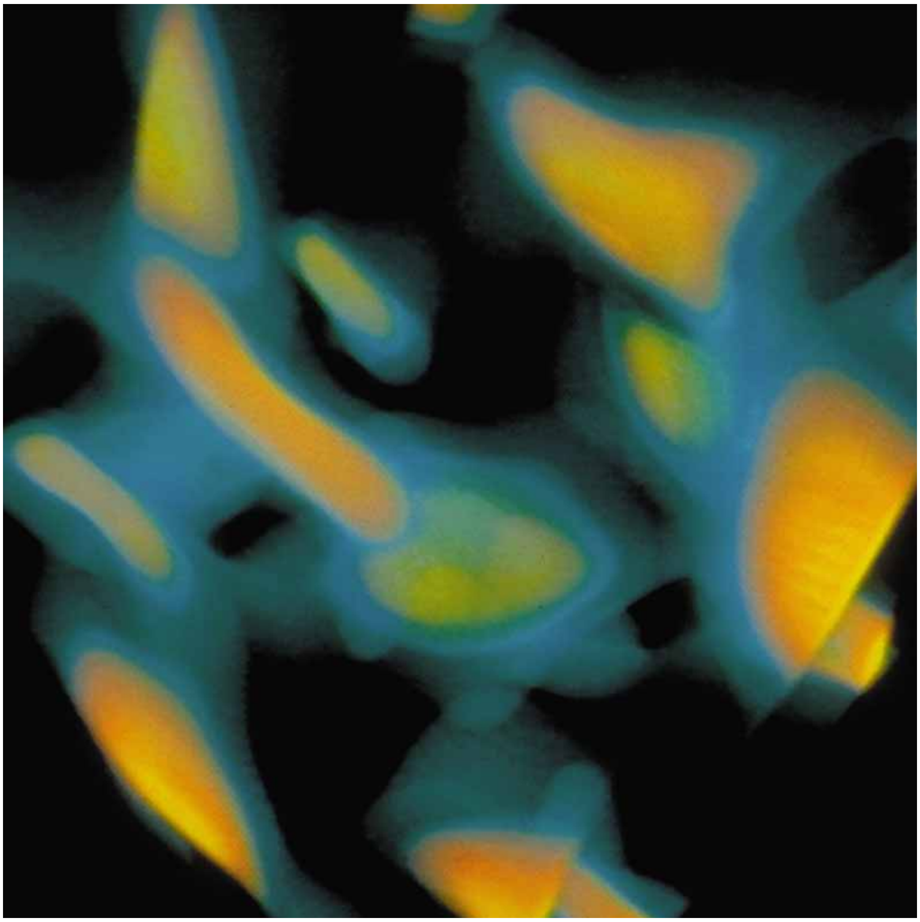
Director
STEVE HUNT

Animation
STEVE HUNT

Graphic Conception
STEVE HUNT

Contact
MARIE-ANNE FONTENIER

SUP Info Com
10, rue Henri Matisse
59300 Aulnoy Lez Valenciennes,
FRANCE
+33.1.27.28.42.42
+33.1.16.27.28.42.41 fax



In the Forest

This animation is the opening title for a Japanese movie program.

Director
KUMIKO HOSAKA

CG Director
YUMIKO HASHIMOTO

Contact
KUMIKO HOSAKA

Tokyo Broadcasting System, Inc.
5-3-6 Akasaka Minato-ku
Tokyo 107-06 JAPAN
+81.3.5571.3975
+81.3.5571.2055 fax
hqm02066@niftyserve.or.jp

Introduction to Human Rights

The stars of this 60-second TV commercial are the computer-animated Lee family, who act out the six basic rights being stressed by the Hong Kong government. A unique clay-mation look was adopted to achieve a warmer and less high-tech appearance.

Visual Director
CHAN KA-HING

Government Information Services
JUNE TONG, WINNIE TO

Centro
RINGO LEE, KENNY CHOW, VINCENT WONG, DAPHNE WONG, CYNTHIA KWONG, CHRISTINA YAN

Contact
LUI YEUNG

Centro Digital Pictures Ltd.
Room 601-605
HKITC
72 Tat Chee Avenue
Kowloon Tong, HONG KONG
+852.2319.6688
+852.2779.6597 fax
ylui@centro.com.hk

Instant d'Apres

Producer
MARIE-ANNE FONTENIER

Scene Artist
LAURENT DEBARGE

Animation
LAURENT DEBARGE

Conception Graphics
LAURENT DEBARGE

Hardware
PC

Software
3D STUDIO

Contact
MARIE-ANNE FONTENIER

SUP Info Com
10, rue Henri Matisse
59300 Aulnoy Les Valenciennes, FRANCE
+33.1.27.284242
+33.1.27.284241 fax

Isle Of You

The Poet Laureate of Florida calls "Isle Of You" a word song rather than a poem. It introduces individual vowels as subjects of animation and changes the meanings of words in synchrony with the visual imagery of the animation. The animator draws from the meanings to illustrate the changes.

Producer
FLORIDA CENTER FOR ELECTRONIC COMMUNICATION

Contributors
KAREN NIR

EDMUND SKELLINGS
Poet Laureate of Florida

Contact
KAREN NIR

Florida Center for Electronic Communication
220 SE Second Avenue
Fort Lauderdale, Florida 33301 USA
+1.954.760.5618
+1.954.468.2740 fax
nir@Laureate.cec.fau.edu

Itsibitsihonolulu strandbikini

Producer
CHRISTIAN WECKERLE

Director
CHRISTIAN WECKERLE

Animation
CHRISTIAN WECKERLE

Graphic Conception
CHRISTIAN WECKERLE

Music
RANIER BERTRAM

Contact
MANFRED EISENBEIS

Academy of Media Arts
Peter Welter Platz 2
50676 Koln, GERMANY
+49.221.201.89123
+49.221.201.89215 fax

Joe's Apartment-Funky Towel

Joe's only friends are the talking roaches that infest his lower east side apartment. In this video, they prepare for Joe's first date by throwing a party of their own in his funky bathroom, and in the process, pay homage to every imaginable musical style.

Producer
NINA RAPPAPORT

Director of Animation
CHRIS WEDGE

Digital Effects Supervisor
SAM RICHARDS

Supervising Animator
CARLOS SALDANHA

Sequence Supervisor
JAN CARLEE

Supervising Technical Animator
MITCH KOPELMAN

Blue Sky Productions Executive Producer
ALISON BROWN

Lighting Designer
JOHN KAHRS

Software Designer
CARL LUDWIG

Technical Animators
RHETT BENNATT, RHETT COLLIER, THANE HAWKINS, ROB JENSEN, HILMAR KOCH, LUTZ MULLER, CHRIS TRIMBLE, MAURICE VAN SWAAIJ

Animators
NINA BAFARO, JIM BRESNAHAN, PETER CARISI-DELAPPE, DOUG DOOLEY, JOHN KAHRS, STEVE TALKOWSKI, AIMEE WONSETLER-WHITING

Modeling
TOM BISOGNO, JIM BRESNAHAN, ALEX LEVENSON

Research & Development
RICHARD HADSELL, TREVOR THOMSON, EUGENE TROUBETSKOY

Computer Animation Coordinator
CINDY BROLSMA

Production Assistant
CHRISTINA REYES

Editor
TIM NORDQUIST

Assistant Editor
FRITZ ARCHER

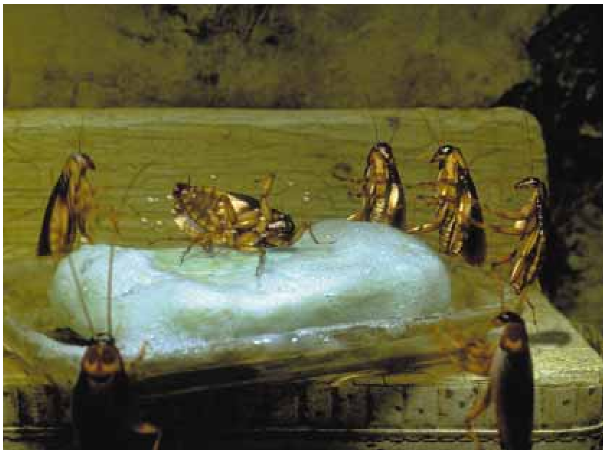
Senior Digital Paint
JOHN SICZEWICZ

Digital Paint
LINDA CALDWELL

Mac Artist
ELEANOR SHELTON

Contact
CHRISTINA REYES

Blue Sky Productions, Inc.
100 Executive Boulevard
Ossining, New York 10562 USA
+1.914.941.5260
+1.914.923.9058 FAX
chrissie@blueskyprod.com



Joe's Apartment Roach Rally

Joe has declared war on the roaches that infest his apartment, and they have beaten him badly. In this scene, the roaches show true compassion and rally to give Joe a new lease on life.

Producer
NINA RAPPAPORT

Director of Animation
CHRIS WEDGE

Digital Effects Supervisor
SAM RICHARDS

Supervising Animator
CARLOS SALDANHA

Sequence Supervisor
JAN CARLEE

Supervising Technical Animator
MITCH KOPELMAN

Blue Sky Productions Executive Producer
ALISON BROWN

Lighting Designer
JOHN KAHRS

Software Designer
CARL LUDWIG

Technical Animators
RHETT BENNATT, RHETT COLLIER, THANE HAWKINS, ROB JENSEN, HILMAR KOCH, LUTZ MULLER, CHRIS TRIMBLE, MAURICE VAN SWAAIJ

Animators
NINA BAFARO, JIM BRESNAHAN, PETER CARISI-DELAPPE, DOUG DOOLEY, JOHN KAHRS, STEVE TALKOWSKI, AIMEE WONSETLER-WHITING

Modeling
TOM BISOGNO, JIM BRESNAHAN, ALEX LEVENSON

Research & Development
RICHARD HADSELL, TREVOR THOMSON, EUGENE TROUBETSKOY

Computer Animation Coordinator
CINDY BROLSMA

Production Assistant
CHRISTINA REYES

Editor
TIM NORDQUIST

Assistant Editor
FRITZ ARCHER

Senior Digital Paint
JOHN SICZEWICZ

Digital Paint
LINDA CALDWELL

Mac Artist
ELEANOR SHELTON

Contact
CHRISTINA REYES

Blue Sky Productions, Inc.
100 Executive Boulevard
Ossining, New York 10562 USA
+1.914.941.5260
+1.914.923.9058 fax
chrissie@blueskyprod.com

Krakken

Based on creatures designed by Dougal Dixon, Krakken is a five-minute show that brings the audience to the ocean 20 million years in the future.

Producer
XAVIER NICOLAS

Director
JERZY KULAR

Art Director
JEAN-FRANCOIS HENRY

Contact
XAVIER NICOLAS

ExMachina
22 Rue Hegesippe Moreau
75018 Paris, FRANCE
+33.1.44.90.11.99
+33.1.4490.11.91 fax

La Stele

Producer
MARIE-ANNE FONTENIER

Director
C. DUPUIS, G. NIQUET, S. NAZE

Animation
C. DUPUIS, G. NIQUET, S. NAZE

Graphic Conception
C. DUPUIS, G. NIQUET, S. NAZE

Art Director
C. DUPUIS, G. NIQUET, S. NAZE

Contact
MARIE-ANNE FONTENIER

SUP Info Com
10, rue Henri Matisse
59300 Aulnoy Lez Valenciennes, FRANCE
+33.1.27.28.42.42
+33.1.16.27.28.42.41 fax

Le Flipper

Producer
PIERRE BUFFIN, BUF COMPAGNIE

Director
BUF COMPAGNIE

Animation
BUF COMPAGNIE

Graphic Conception
BUF COMPAGNIE

Contact
PIERRE BUFFIN

Buf Compagnie
9 Avenue de Villiers
75017 Paris, FRANCE
+33.1.47.66.02.00
+33.1.47.66.03.02 fax

"M" The Invisible Universe

M' The Invisible Universe" is a PBS series scheduled for release in autumn 1996. The program documents the work of mathematicians in their quest to interpret the principles that define the universe.

Producer
HOME RUN PICTURES

Animation
HOME RUN PICTURES

Client Producer
WQED, PITTSBURGH

Executive Producer
GREG ANDORFER

Episode Producers
DAVID ELISCO, MARY RAWSON, JOE SEAMANS

Animation Director
TOM CASEY

Animators
WENDY JOBE, FRED JACOBS, DAWN LOHMEYER

Contact
TOM CASEY

Home Run Pictures
One Market Street
Pittsburgh, Pennsylvania 15222
USA
+1.412.391.8200
+1.412.391.0185 fax
tom@hripictures.com

Ma La Notte

Producer
WILLIAM DI PAOLO, RAI

Scene Artist
WILLIAM DI PAOLO

Animation
WILLIAM DI PAOLO

Graphic Connection
WILLIAM DI PAOLO

Artistic Director
WILLIAM DI PAOLO

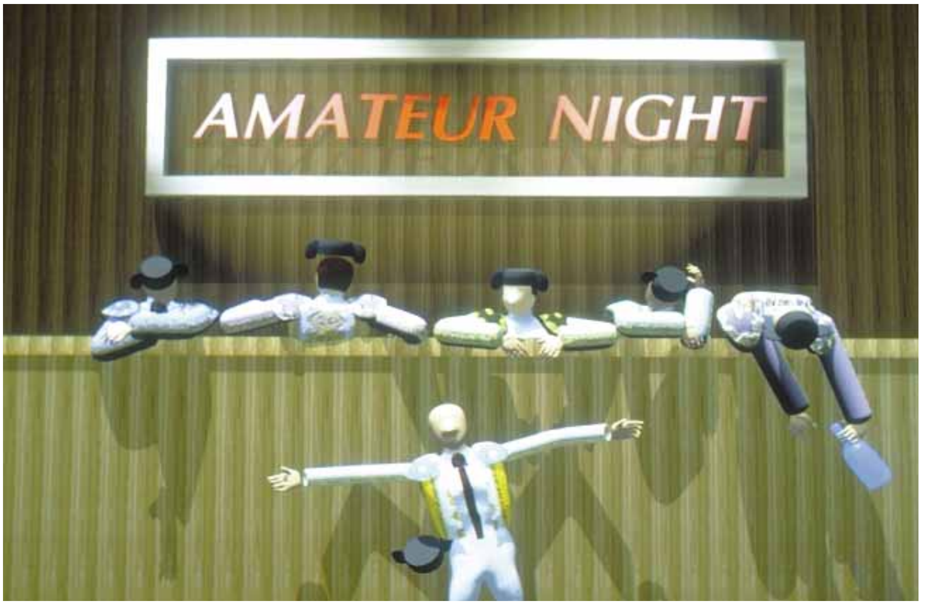
Music
ANDREA TOSINI, RENATO DI SIEMO

Hardware
HARRIET, HARRY

Software
QUANTEL

Contact
WILLIAM DI PAOLO

RAI
Via Salaria 1033
00138 Rome, ITALY
+39.6.36.868264
+39.6.88.02334 fax



Matador

An overly anxious man unfortunately finds out what it is like to be a bullfighter on "Amateur Night."

Producer
FABIO DANIEL TOVAR

Contributors
RINGLING SCHOOL OF ART & DESIGN, RINGLING MULTIMEDIA CORP., DOUG DOOLEY, BRIAN MATHEWS, MOM

Contact
FABIO DANIEL TOVAR

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34243 USA
FabioT@aol.com

Metal Hat

This work shows a metal hat as it changes color and shape.

Producer
KAZUMA MORINO

Artist
KAZUMA MORINO

Music
YOSHIYUKI USUI

Contact
KAZUMA MORINO

Taiyo Kikaku Co., Ltd.
2.26.3 Nishishinbashi, Minato-ku
Tokyo 105, JAPAN
+81.3.3436.4540
+81.3.3436.0175 fax

MMB & Renaissance

The Multi Mega Book is a giant interactive book installation that allows viewers to slip into the Renaissance. This animation shows the most striking aspects of the Renaissance: architecture, sculpture, painting, printed books, and other innovations.

Contact
FRANZ FISCHNALLER
YESENIA MAHARA SINGH

F.A.B.R.I.Cators
Via Fratelli Bronzetti No.6
20129 Milano, ITALY
+39.2.70128233
+39.2.76110498 fax
fabricat@galactica.it

Martini "Pop Art"

A computer-generated odyssey of a red dot as it travels through a universe of geometric op-art patterns: a black dot matrix, a keyhole, spirographs, and wavy lines. Created for Martini and Rossi.

Producer
CURIOUS PICTURES

Executive Producer
DAVID STARR

Producers
KEVIN MERCADO, MERIDITH BROWN

Director
ELLEN KAHN

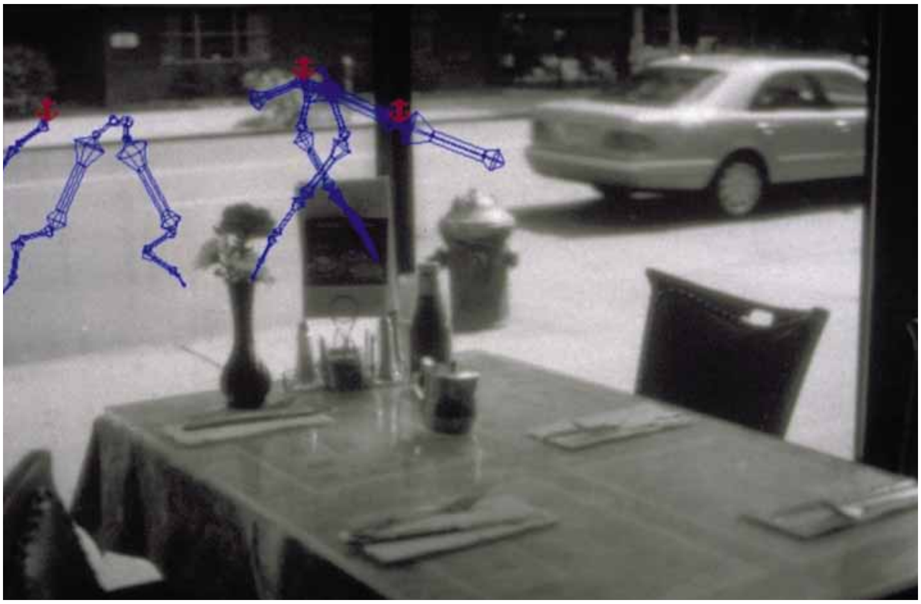
Technical Director
STEVE KATZ

Creative Director
MIKE BADE

Animator
HAROLD MOSS

Contact
STEVEN D. KATZ
DAVID STARR

Curious Pictures
440 Lafayette Street
New York, New York 10003 USA
+1.212.674.1400
+1.212.674.0081 fax



Mercedes Rhino How-To

How do you get one of the most unpredictable, dangerous, and impossible-to-train animals – a rhinoceros – to run through the streets of New York City? Simple. You combine the artistry of photo-realistic computer graphics with live-action background places and voila! You eliminate the need for an animal trainer.

Executive Producer
ED ULBRICH

Visual Effects Producer
MARGAUX MACKEY

Computer Graphics Producer
VICTORIA ALONSO

Visual Effects Supervisor
RAY GIARRATANA

Computer Graphics Supervisor
RANDALL ROSA

Presentation Editor
ROBERT DOOLITTLE

Contact
BOB HOFFMAN

Digital Domain
300 Rose Avenue
Venice, California 90291 USA
+1.310.314.2981
bhoffman@d2.com

Mouse Embryo Visualization

A three-dimensional model of a mouse embryo is reconstructed from serial microscopic cross-sections. The demonstrated reconstruction process utilizes a novel active contour model, semi-automatic topology reconstruction, triangulation methods, and semi-transparent visualization.

Producer
HIDEO YAMASHITA

Directors
ROMAN DURIKOVIC, KAZUFUMI KANEDA

Animation
ROMAN DURIKOVIC

Music
MASAFUMI HIRATA

Narrator
PAUL WILLIAMS

Hardware
SILICON GRAPHICS INDIGO2

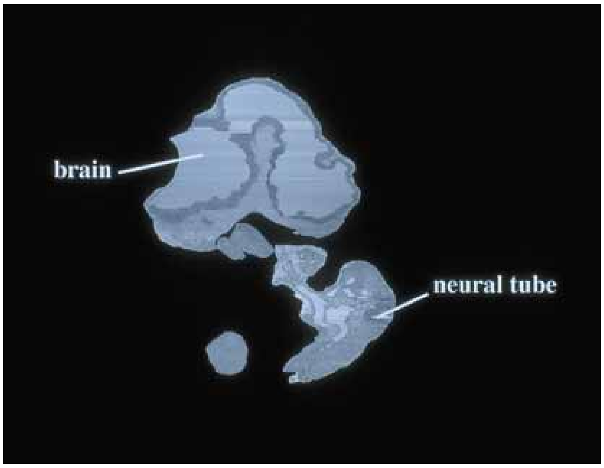
Software
IN-HOUSE BIOMEDICAL VISUALIZATION SYSTEM

Produced at:
ELECTRIC MACHINERY LABORATORY FACULTY OF ENGINEERING, HIROSHIMA UNIVERSITY

Special thanks to:
AKINAO G. SATO, MINEO YASUDA, HIROSHIMA UNIVERSITY SCHOOL OF MEDICINE

Contact
HIDEO YAMASHITA

EML, Faculty of Engineering
Hiroshima University
1-4-1 Kagamiyama
Higashi-hiroshima, 739 JAPAN
+81.824.24.7665
+81.824.22.7195 fax
yama@eml.hiroshima-u.ac.jp



MTV Music Awards 95 les Numeros de Cirque

Producer
ERIC COIGNOUX, MIKROS IMAGE

Scene artist
ERIC COIGNOUX

Animation
M. CHARPENTIER, F. GUILGYL

Graphic Conception
ERIC COIGNOUX

Artistic Director
ERIC COIGNOUX

Music
NOVA PRODUCTIONS/FRED LEONARD

Contact
ERIC COIGNOUX

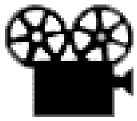
Mikros Image
7, rue Biscornet
75012 Paris, FRANCE
+33.1.44.752100
+33.1.44.752101 FAX

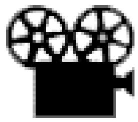
Music

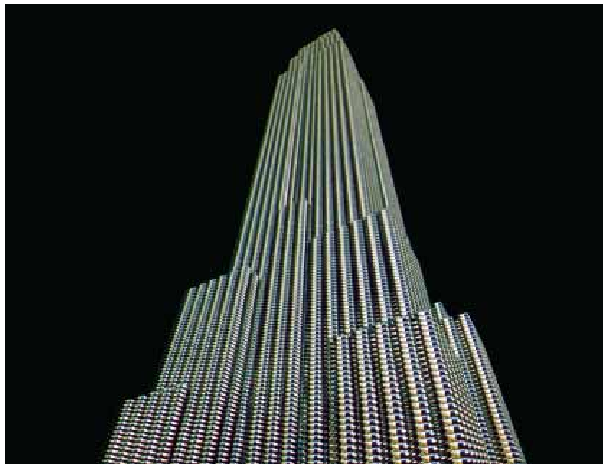
Producer
JORG SCHWAMSTECHER, EHLER GIESE & PARTNER

Contact
JORG SCHWAMSTECHER

Ehler Giese & Partner
Eionbkizchstr. 73
10119 Berlin, GERMANY
+49.30.44380574
+49.30.44380551 fax







Naked Empire

This animation was rendered using the method described in the SIGGRAPH 96 paper entitled, "Hierarchical Polygon Tiling with Coverage Masks." Hierarchical polygon tiling renders enormously complex models, such as this video's 167-million-polygon model of the Empire State Building, in only a few minutes per frame.

Contact
NED GREENE

Apple Computer
1 Infinite Loop MS 301-3J
Cupertino, California 95014 USA
+1.408.974.9491
+1.408.862.5520 fax
greene@apple.com

News

Producer
SATOSHI KITAHARA

Music
H. KAWADA

Contact
SATOSHI KITAHARA

SEGA Enterprises, LTD.
AM R&D Department #3
1-2-12 Haneda, Ohta-ku
Tokyo 144 JAPAN
+81.3.5736.7237
+81.3.5736.7264 fax

Nightfall

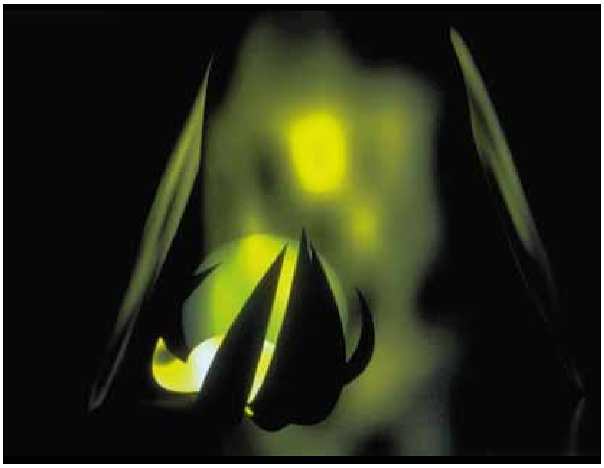
"Nightfall" is a moody and haunting piece that contains imagery referring to death and rebirth, a meditation on the cyclical nature of transformation that arises from the artist's near-death experience.

Producer
RAYMOND CHEN

Music
FRANK ROTHKAMM

Contact
RAYMOND CHEN

Pratt Intstitute
4422 Via Marina #P-79
Marina Del Ray, California 90292
USA
+1.310.448.7500
+1.310.578.0334 fax
chen@rhythm.com



Nightlight

The story of a man and the objects of his affections.

Producer
GEORGE M. NADEAU

Music
DEVIN KIRSCHNER

Contact
GEORGE M. NADEAU

Rochester Institute of Technology
301 Meigs Street #2
Rochester, New York 14607 USA
gmn4257@rit.edu

Oldsmobile Caught Their Eye

In this 60-second movie portraying a monumental event, the Statue of Liberty comes to life and lifts an Oldsmobile Aurora off the Staten Island Ferry to examine its fine craftsmanship. Rendering and animating the first photo-realistic, full-motion Statue of Liberty presented unique technical and creative challenges that R/GA solved with both SoftImage and proprietary software.

Producer
MARIA CRISCUOLO

Visual Effects and Digital Post
GREENBERG ASSOCIATES

Director of Computer Graphics
MARK VOELPEL

Visual Effects Supervisor
ED MANNING

CG Project Leader
RAFAEL CASTELBLANCO

CG Animators
EILEEN O'NEILL, DAVID BAROSIN, JASON STROUGO, JIM HUNDERTMARK, STEVE BLAKEY, JOHN MUSUMECI

Lead Technical Director
HENRY KAUFMAN

Technical Directors
DIRK VAN GELDER, CLAY BUDIN

Lead CG Artists
IRENE KIM, MICHAEL ERINGIS, PETER OBERDORFER

CG Artists
JOE FITZGIBBON, JEFF LINNELL

CG Coordinator
KATIE HASER

Assistant CG Coordinator
JOSHUA MOSS

Lead Special Effects Editor
BURTIS SCOTT

Special Effects Editor
DAVID ELKINS

Flame Artist
MARK CASEY

Assistant Special Effects Artist
THOMAS DOWNS

Executive Producer
BOB SWENSEN

Assistant Producer
IRKA SENG

Advertising Agency
LEO BURNETT COMPANY, INC.

Group Creative Director
GREG TAUBENECK

Creative Director/Copywriter
JERRY GAGGIANO

Art Director
ANGELO JULIANO

Executive Producer
RON NELKEN

Agency Producer
BOB HARLEY

Production Company
GIRALDISUAREZ

Director
BOB GIRALDI

Executive Producers
DEBBIE MERLIN/PATTY GREANEY

Director of Photography
PAUL GOLDSMITH

Contact
MARK VOELPEL

R/Greenberg Associates
350 West 59th Street
New York, New York10018 USA
+1.212.946.4077
+1.212.946.4010 FAX
mark@rga.com

Paris 1999

Research into the development of moving pictures and the evolution of flying machines in the 19th century provided the inspiration for "Paris 1999." This video tells an adventurous story of time travel and a journey around the world, reminiscent of the Jules Verne story.

Producer
MATHIAS LORENZ

Hardware
MACINTOSH QUADRA 900

Software
STRATASTUDIO PRO, ADOBE PREMIERE, SOUNDEDITPRO

Contact
MATHIAS LORENZ

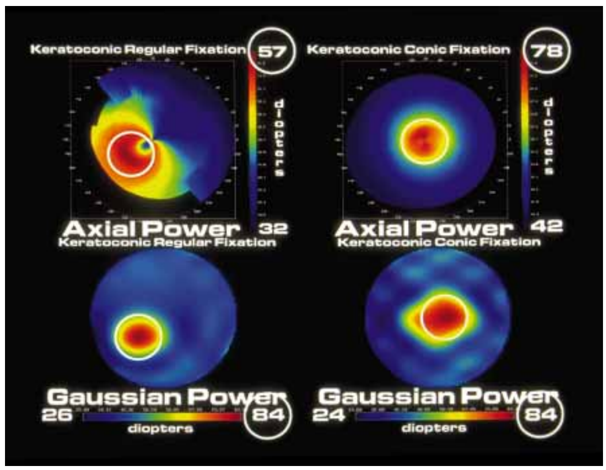
Dallbregen 96B
22523 Hamburg, GERMANY
+1.49.40.574286

Optical Corneal Visualization

This video animation simulates data generated with the algorithm described in the SIGGRAPH 96 paper "Reconstructing Curved Surfaces from Specular Reflection Patterns Using Spline Surface Fitting of Normals," by Mark Halstead of the Optical Research Project.

Contact
BRIAN A. BARSKY

University of California at Berkeley
Computer Science Division
785 Soda Hall
Berkeley, California 94720 USA
+1.510.642.9838
+1.510.642-5775 FAX
barsky@cs.berkeley.edu



Period

This short film marks the crossroad between the beginning and the end, between death and life. The sea, which has been deeply affected by the sinking, exhausted dirigible, goes through a symbolic death, a necessary passage that enables it to be born again.

Producer
KOOHJI NAKASHIMA

Contributor
EXMACHINA

Contact
TOSHIBA CORPORATION

Multimedia Divison
1-1-1, Shibaura 1-Chome
Minato-Ku
Tokyo 105-01 JAPAN
+81.3.3457.8598
+81.3.5444.9430 fax
mushiaki@mmd.toshiba.co.jp

Petula & Freddie

Petula & Freddie" is a humorous and slightly twisted animation intended for all age groups. Petula is a home shopping channel viewer who suddenly realizes that her dog is missing. She looks for him until something else catches her attention.

Producer
INGRID M. YEGROS

Vocal Talent
MARY MANNING, BRIAN KINNEY, ED CHEETHAM, MICHELLE COWART

Technical Support
HARRY TANOVICH

Audo Support
PHIL CHIOCCHIO

Contact
INGRID M. YEGROS

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34243 USA
+1.941.359.7574

Placebo

"Placebo" is a commentary on misplaced priorities and destructive social programming in a consumer society. The group project explored the integration of computer-generated environments and effects, pencil-rendered characters, video, and the use of limited animation techniques.

Director
THOMAS PUSHPATHADAM

Art Direction
THOMAS PUSHPATHADAM

CG Animation
JEAN-CLAUDE KALACHE, STEWART WILLIAM MILNE, QUINTIN KING, THOMAS PUSHPATHADAM

Character Animation
THOMAS PUSHPATHADAM

Models & Lighting
JEAN-CLAUDE KALACHE

Raw Video Footage
STEWART WILLIAM MILNE

CG Effects and Software Development
QUINTIN KING

Sound
JEAN-CLAUDE KALACHE, STEWART WILLIAM MILNE

Editing
STEWART WILLIAM MILNE

Instructors
KAREN HILLIER-WOODFIN,THUY TRAN

Special Thanks
JEFF GRISWOLD, BILL JENKS, STEPHEN KING, COMPANY B OF THE TEXAS A&M CORPS OF CADETS, TEXAS A&M SUPERCOMPUTING GROUP, FONDS POUR LA FORMATION DE CHERCHEURS ET L'AIDE A LA RECHERCHÉ, QUÉBEC

Hardware
SILICON GRAPHICS, MACINTOSH

Software
WAVEFRONT, EDDIE, PHOTOSHOP

Contact
THOMAS PUSHPATHADAM

Visualization Laboratory
Texas A&M University
215 Langford Center A
College Station, Texas 77843 USA
+1.409.845.3465
+1.409.845.4491 fax
qmot@viz.tamu.edu

Plymouth Neon Popcorn

Pacific Data Images provided 3D animation and visual effects for a recent commercial in which a car pops the corn in a cornfield as it zips along a rural road. PDI programmers developed a new particle animation system to create a realistic-looking explosion of popcorn. Other techniques employed on this spot included particle animation, computer graphics corn and husks, matte painting, and compositing.

Producer
LES HUNTER

Computer Animation
PACIFIC DATA IMAGES

Visual Effects Producer
LES HUNTER

Visual Effects Supervisor
MIKE NECCI

Visual Effects Animators
PHILLIPPE GLUCKMAN, PAUL WANG

Modeler/Animator
KONRAD DUNTON

Assistant Animators
CURT STEWART, CECILE PICARD, CHANDA CUMMINGS MATTE PAINTING: MICHAEL LLOYD

Illustration
DAVID DOEPP

PDI Editorial
BILL ROGINA

Agency
BOZELL

Live Action Production
G.M.S.

Director
MIKAEL SALOMON

Editorial
JEFF WISHENGRAD
Miller, Wishengrad, Peacock

Contact
JUDY CONNER

Pacific Data Images
3101 Park Boulevard
Palo Alto, California 94306 USA
+1.415.846.8100
+1.415.846.8103 fax
jconner@pdi.com

Rofly - Fly Hard

Producer
VCC, HAMBURG

Production
VCC, HAMBURG

Producer
ROBERRT KUHL

Director
WOLFGANG EMMRICH

Co-Directors
CHRISTIAN DORN, ROBERT KUHL

Computer Animation
WOLFGANG EMMRICH

Human Actor
MICHAEL GORITSCHNIG

Editing and Special Effects
CHRISTIAN DORN

Technical Support
FRANK SCHLIEFER

Mac Artist
SEBASTIAN RATSCH

Motion Control Shot
OPTICAL ART

Music and Sound Effects
STUDIO FUNK

Contact
WOLFGAN EMMRICH

Video Copy Company
Doormannsweg 43
20259 Hamburg, GERMANY
+49.40.431.69.146
+49.40.430.1789 fax
100723.2101@compuserve.com

Rolling Stones Like a Rolling Stone

Producer
BUF COMPAGNIE

Animation
BUF COMPAGNIE

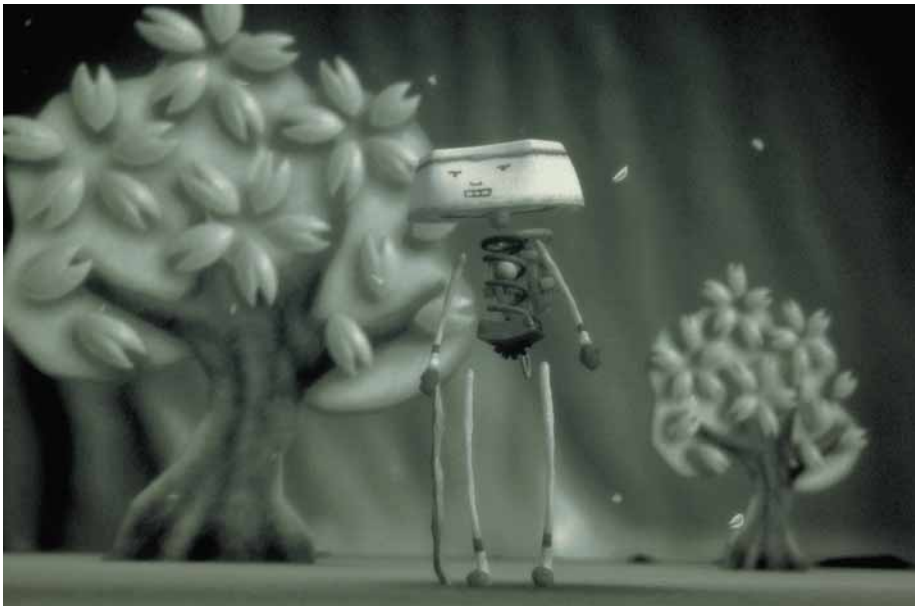
Graphic Conception
BUF COMPAGNIE

Hardware
HARRIET, HARRY

Software
QUANTEL

Contact
PIERRE BUFFIN

BUF Compagnie
9 Avenue de Villiers
75017 Paris, FRANCE
+33.1.47.660200
+33.1.47.660302 FAX
imagina@imagina.ina.fr



Sakuratei

The story represents a future experimental attempt to give a robot humanity. The animation uses uniquely Japanese imagery, including folk art and miniature gardens.

Produced by
LINKS CORPORATION

Executive Produce
TAMICHIKA SASAJI

Producer
MIKITAKA KURASAWA

Director
KOJI MATSUOKA

Creative Director/ Digital Artist
TAKU KIMURA

Music
JUN MIYAKE

2nd Creative Director
HIROYUKI SESHITA

Animator
NORIO SAITOH

Visual Effects Animator
MASASHI WATANABE

Model Maker / Assistant Digital Artist
NATSUYO KOBAYASHI

Assistant Model Maker
TOSHIHIRO NOMURA

Production Manager
MASABUMI TANAKA

Motion Capture
IMAGICA CORPORATION

Technical Director
TETSUE KAWANO

Coordinator
SHOGO YABUUCHI

Motion Talents
HIRO MATSUMOTO, MASUMI KAWAI, MIYAKO SHIDAHARA

Sound Design
AIR SOUND

Thanks to
YOSHIHISA HIRANO, IKUO NISHII, NORIKO KURACHI, TSUTOMU NOMOTO

Dedicated to
HIROHIKO IWASHITA

Contact
NORIKO KURACHI

Links Corporation
2-14-1 Higashi-Gotanda
Shinagawa-Ku
Tokyo, JAPAN
+81.3.5420.5310
+81.3.5420.5330 fax
noriko@links.imagica.co.jp

Shark Attack Sequence from "James and the Giant Peach"

This excerpt produced by Sony Pictures Imageworks for the Walt Disney release of Henry Selick's "James and the Giant Peach" (Skellington Productions) includes the shark attack sequence. The video clip features stop motion and computer animation combined in complex digital composites. Computer graphics elements include a mechanical shark; an ocean of waves, spray and foam; and the flock of seagulls integrated with scanned footage of the stop-motion puppets and sky background. The resulting effect is intended to give the computer-graphics characters and environments the look of stop-motion animation and to blend these elements into a single world.

Producer
SONY PICTURES IMAGEWORKS

Visual Effects Supervisor
SCOTT E. ANDERSON

Visual Effects Producer
MICKEY MCGOVERN

Computer Graphics Supervisor
JEROME CHEN

Lighting Supervisor/Lead Animator
LOUIS CETORELLI

Animation Supervisor
HARRY WALTON

Senior Technical Director
RON BRINKMANN

Visual Effects Editor
AUDREY CHANG

Visual Effects Coordinator
JEANETTE VOLTURNO

Art Directors
MICHAEL SCHEFFE, JAMIE RAMA

Animators
ALLEN EDWARDS, ALEX SOKOLOFF, DAVID VALLONE, PETER WARNER

Lead Compositors
HEATHER DAVIS, M. SCOTT MCKEE

Compositors
LISA FOSTER, STEVE KENNEDY

3D FX Animator
ARNAUD HERVAS

Particle Animators
MIKE PERRY, TIM TERAMOTO

Technical Director
MICHAEL TIGAR

Software Engineers
DEV MANNEMELA, ROBERT MINSK

Modeler
KEVIN HUDSON

Roto Artists
KIKI CANDELA, SUZY BROWN

Senior Technical Assistants
STEPHEN KOWALSKI, DAVID TAKAYAMA

Technical Assistants
JANEL ALEXANDER, BILL BALL, JOHN DECKER

Production Assistants
NIKKI BELL, JASON HANEL

Runner
GUY WIEDMANN

I/O Supervisor
DENNIS WEBB

Lead Film Recordist
JOHN STRAUSS

Film Recording Technicians
CHRIS LEONE, CHRIS TSONGAS

Editorial Supervisor
MICHAEL MOORE

Director of Software
CAROLINE ALLEN

Senior System Engineer
ALBERTO VELEZ

Systems Engineer
DEAN MIYA

System Administrator/Resource Manager
TED ALEXANDRE

System Technician
JESSE CARLISLE

Digital Production Manager/Resource Manager
GAYLE REZNIK

Digital Production Coordinator
KATYA CULBERG

Administrative Office Coordinator
CATHY DEUTMEYER

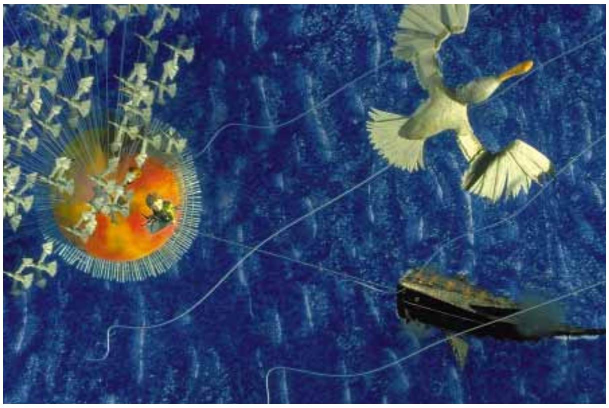
Head of Digital Production
BILL SCHULTZ

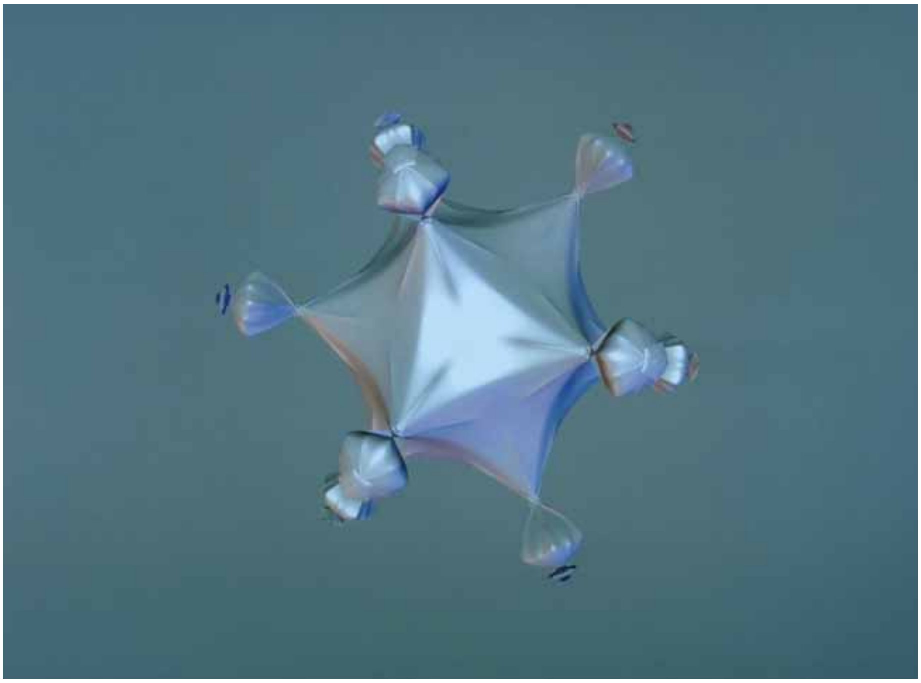
Executive Producer
GEORGE MERKERT

General Manager
BILL BIRRELL

Contact
JEROME CHEN

Sony Pictures Imageworks
10202 West Washington Boulevard
Culver City, California 90232 USA
+1.310.280,7600
+1.310.280.2342
jerome@spimageworks.com





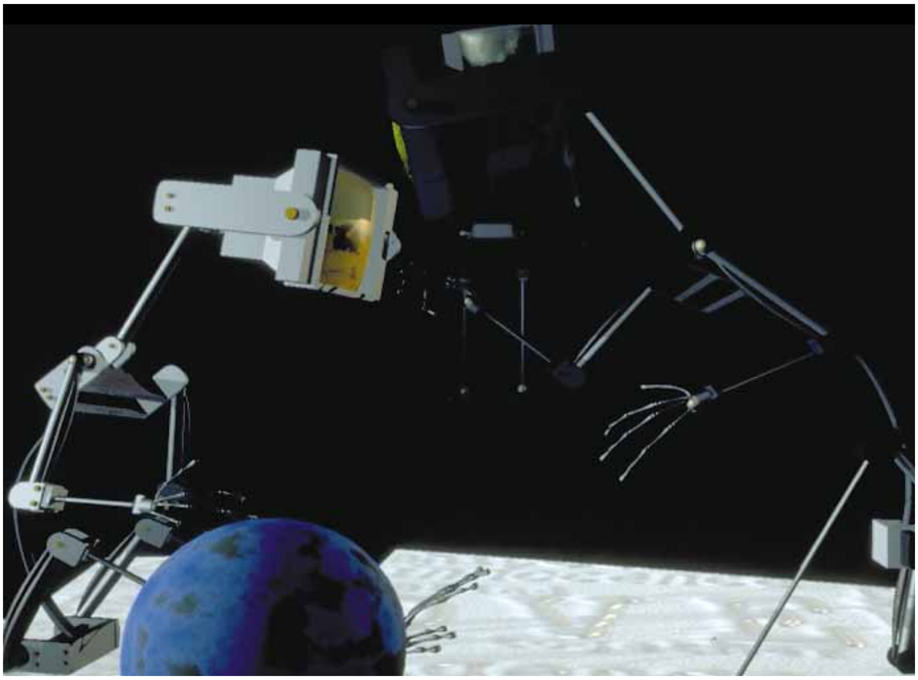
Subdivision Kaleidoscope

Subdivision is an efficient way to generate smooth surfaces. The appearance of the limit surface is largely determined by a few parameters of the scheme. Visually complicated shapes can be obtained from simple intitial polyhedra. Divergence of subdivision for large-value parameters also produces interesting visual effects. More details and information on the subdivision algorithms in this animation are in the SIGGRAPH 96 paper "Interpolating Subdivision for Meshes of Arbitrary Topology."

Producer
DENIS ZORIN

Contact
DENIS ZORIN

California Institute of Technology
139-74, Caltech
Pasadena, California 91125 USA
+1.818.395.2820
dzorin@gg.caltech.edu



Television Monster

This film deals with how the media glorify the evils of society. It depicts evil as a mechanical creature that lives in a dark, violent world, destroying everything good. The creature happens on two children and must choose between good and evil.

Producer
MIKE GASAWAY

Contributors
DOUG PFIEFER, BRENT GILMARTIN, BRIAN POER

Contact
MIKE GASAWAY
12790 Primrose Lane #313
Eden Prairie, Minnesota 55344
USA
+1.612.996.6228
+1.612.996.6001 fax
mikee@ivi.com

The Architecture of Decay: Giovanni Batista Piranesi/Lebbeus Woods

The theme of this year's research project for the Digital Design Lab at the Columbia University Graduate School of Architecture is to explore the unbuilt works of two architects, Giovanni Batista Piranesi and Lebbeus Woods. Both architects represent a tradition of visionary architecture limited to the surface of paper. This animation takes the vision one step further.

Producer
COLUMBIA UNIVERSITY GRADUATE SCHOOL OF ARCHITECTURE DIGITAL DESIGN LAB

Contributors
STEVEN CHEN, PATRICIA FRAZIER, DAMIJIAN SACCIO, LAWRENCE SHUM, SCOTT SINDORF

Sound
RED RAMONA

Digital Mastering
NEW YORK FILM AND ANIMATION

Contact
STEVEN CHEN

Digital Design Lab
Columbia University Graduate
School of Architecture
400 Avery Hall
New York, New York 10027 USA
+1.212.924.2220
+1.212.864.0410 fax
sc367@columbia.edu

The Arrival

For "The Arrival," PDI created computer-generated aliens, rendered with life-like, organic detail, and animated using PDI's proprietary human animation system. An earlier version of this system was used to create digital stunt doubles ("Batman Forever," "Executive Decision") and has been refined to produce realistic musculature, skin, and other life-like attributes.

Live Entertainment Producer
THOMAS G. SMITH

Director
DAVID TWOHY

Visual Effects Producer
CHARLES FINANCE

Digital Visual Effects & Alien Animation
BRANFORD LEWIS

Animation Director
RAMAN HUI

Lighting Supervisor
JEAN M. CUNNINGHAM

EFX/Technical Supervisor
PAUL WANG

Lighting & Alien Gun Design
JOE PALRANG

3-D Paint Artist
DAVID DOEPP

Animators
APURVA SHAH, COLLIN HENNEN, FRED NILSSON, DAVE RADER, PETER PLEVRITIS, TERRY EMMONS

Character Motion and Muscular System
DICK WALSH

Character Technical Director
KAREN SCHNEIDER

Sculpting/Modeling
KONRAD DUNTON

Modeling
CECILE PICARD

Alien Deformation Software
BARRY FOWLER

Assistant Animators
CHANDA CUMMINGS, RACHEL FALK-XANDER, KRISTI HIGGINS

Line Producer
JOHN JR ROBECK

Film Operations
JOHN HANASHIRO

3D Paint Software
LAWRENCE KESTLELOOT

R&D Support
DAN WEXLER, DREW OLBRICH

President
CARL ROSENDAHL

VP/Head of Production
PATTY WOOTON

Additional Support
RICHARD CHUANG, CRAIG RING

Contact
JUDY CONNER

Pacific Data Images
3101 Park Boulevard
Palo Alto, California 94306 USA
+1.415.846.8100
+1.415.846.8103 fax
jconner@pdi.com

The Butterfly Sequence from Columbia Pictures "The Craft"

This example of photo- realistic character animation is one of the very first to be created entirely using Pentium-based computers in full 48-bit color depth (16 bits linear per color channel). It was rendered at the standard 2K resolution. The software used was Autodesk 3D Studio with custom SPI software for RLA format import/export.

Producer
SUZANNE PASTOR

Visual Effects Supervisor
KELLEY RAY

Visual Effects Producer
SUZANNE PASTOR

CG Department Supervisor
FRANK FOSTER

Lead Digital Artist
DAVID SCHAUB

Digital Artists
BRUMMBAER, JANET MCANDLESS, RACHEL NICHOLL, MICHAEL SANCHEZ

Coordinator
ANTHONY J. CECCOMANCINI

Contact
FRANK FOSTER

Sony Pictures Imageworks
10202 West Washington Boulevard
Astaire 2610
Culver City, California 90232 USA
+1.310.280.7603
+1.310.280.4397 fax
frank@spimageworks.com

The Fight

Since this video uses two-person Acclaim Motion Capture, the resulting animation is more realistic than similar animations using traditional techniques.

Contact
ANNMARIE KOENIG

Acclaim Entertainment, Inc.
One Acclaim Plaza
Glen Cove, New York 11542 USA
+1.516.656.2470
+1.516.656.2052 fax
akoenig@akim.com

Inline

UNIX / External

the green man

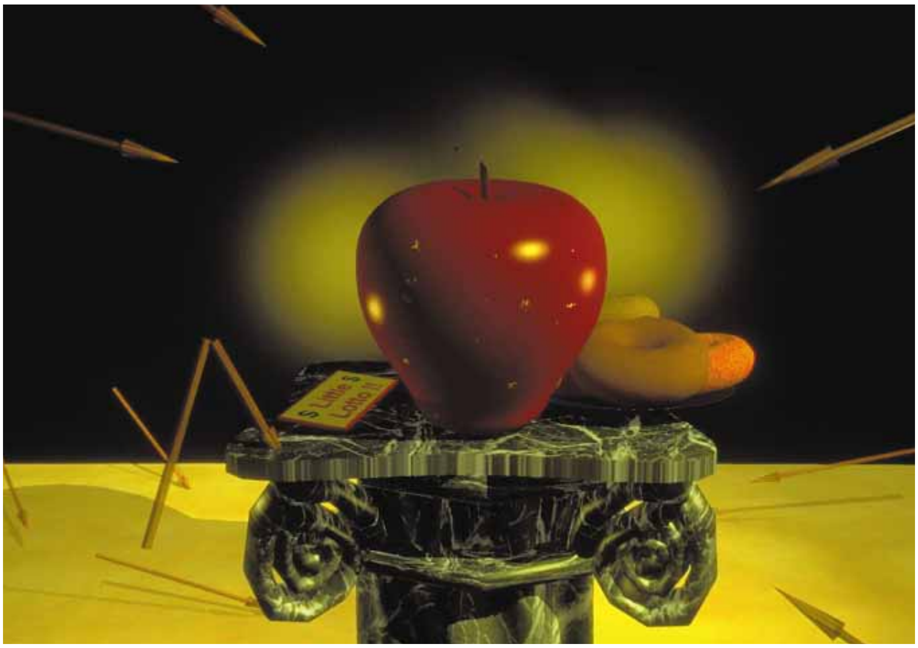
This story of fear and acceptance combines traditional 2D animation with a 3D computer graphics environment. It mimics the look of cartoon reality and gives the animation the rich textures suggestive of hand-drawn artistry.

Producers
P. KEVIN THOMASON, JODI WHITSEL, RANDY HAMMOND, PAT MALOY

Contributors
THUY TRAN, KAREN HILLIER-WOODFIN, JOE B. VAUGHAN, JR.

Contact
KEVIN THOMASON

Texas A&M University
Visualization Laboratory
216 Langford Center A
College Station, Texas 77843 USA
+1.409.845.3465
+1.409.845.4491 fax
kt@viz.tamu.edu



The Little Arrow That Couldn't

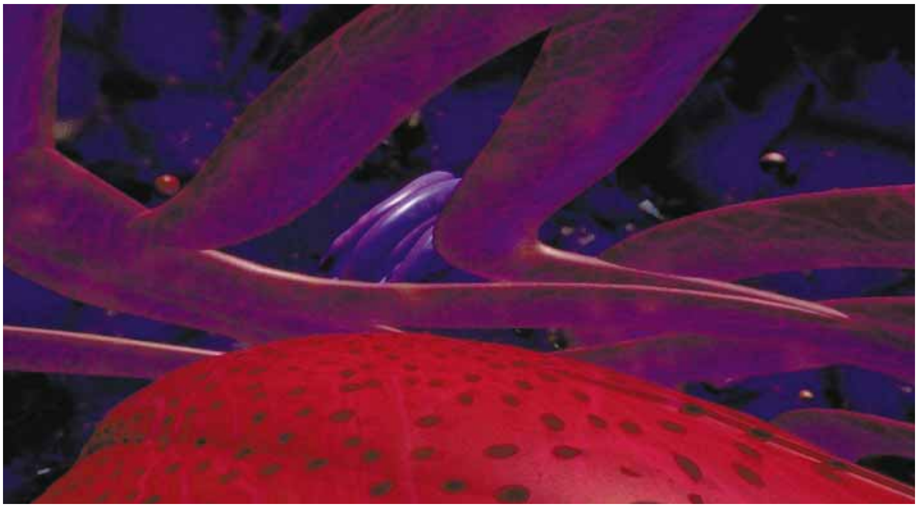
"The Little Arrow that Couldn't" is an animated parody of educational animation. Here, the goal is to explain the mathematical paradoxes of the ancient Greek mathematician, Zero, which preceded calculus.

Producer
CHRISTINA VASILAKIS

Contributor
PAUL NEUMANN

Contact
CHRISTINA VASILAKIS

Electronic Visualization Lab
University of Illinois at Chicago
851 South Morgan, Room 1120
Chicago, Illinois 60607 USA
+1.312.996.3002
+1.312.413.7585 fax
cvasilak@eecs.vic.edu



The Living Cell

"The Living Cell" was created for planetariums, where it provides an educational tour of the workings of the human cell. In this excerpt from the end of the program, the viewer is taken on a final roller-coaster-style ride through a cell as it might appear to a miniature traveler. All cell components are accurately depicted.

Producer
HOME RUN PICTURES

Animation
HOME RUN PICTURES

Client Producer
CARENEGIE SCIENCE CENTER/BUHL PLANETARIUM

Executive Producer
MARTIN RADCLIFF

Animation Director
WENDY JOBE

Technical Director
TOM CASEY

Contact
TOM CASEY

Home Run Pictures
One Market Street
Pittsburgh, Pennsylvania 15222
USA
+1.412.391.8200
+1.412.391.0185 fax
tom@hripictures.com

The Lost Temple Expedition

"The Lost Temple Expedition" is a four-minute motion simulation thrill ride through an underground temple in the jungle.

Producer
BEN STASSEN, NEW WAVE ENTERTAINMENT

Director
MICHEL DENIS

Production Designer
RAY SPENCER

Animators
SIGRID ROUSSEAU, ALAIN SCHMIDT, SHOOTIN P.F. FONTIGNY

Music and Sound
PIERRE LEBECQUE, YVES RENARD

Contact
BEN STASSEN

New Wave Entertainment
308 Oudergemlaan
1040 Brussels, BELGIUM
+32.2.649.9406
+32.2.649.6988 fax

The Maestro Plays

A narrative 3D character animation in which Maestro masterfully plays with words. The result is a charming and unique piece intentionally flat rendered without shading for stylistic purposes, which simulates cel animation.

Producer
DOROS MOTION INC.

Animation Director
DOROS EVANGELIDES

Producer
ROSEMARY KILLEN

Computer Animation
SANDRA LEE AND BEATRIZ JUNQUERA

Computer Models
GREGORY ORDUYAN AND MANUEL DE LANDA

Music
JOHN GUTH

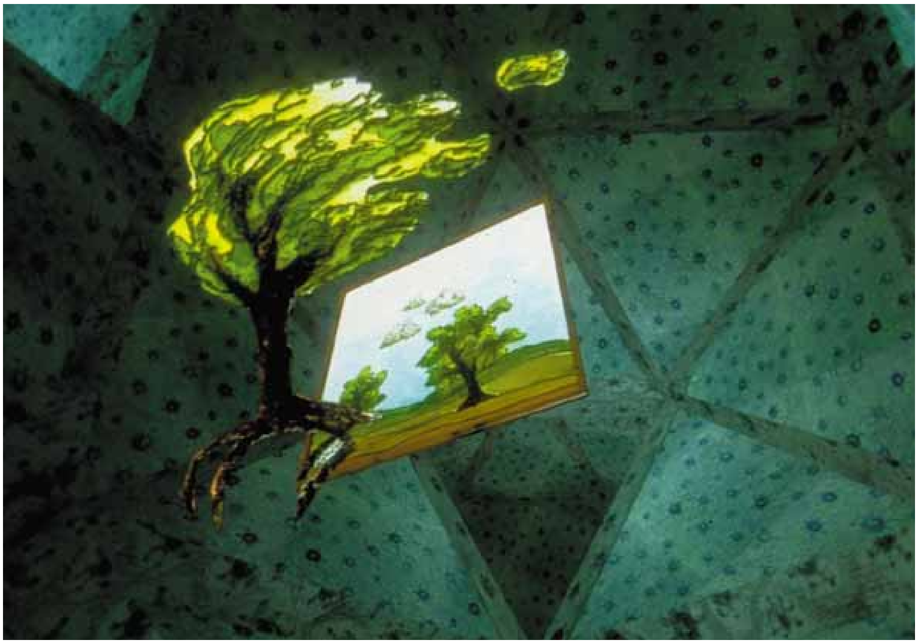
Writer
BILL MARTIN, JR.

Character Design
VLADIMIR RADUNSKY

Additional Layout Artist
JIM PETROPOULOS

Contact
DOROS EVANGELIDES

Doros Motion Inc.
40 West 21st Street #1102
New York, New York 10010 USA
+1.212.243.5520
+1.212.243.5664 fax
doros@visualradio.com



The Ocean

Medicine men, magicians, tantracal and zen masters, and today's psychologists, physicists, mathematicians, and other scientists have been investigating and processing the same topics for nearly 20,000 years of human existence. It is an ancient presentiment that things and ideas are not as simple as they seem to be. Under the surface are hidden layers, spaces, and worlds. In its love of speed, the modern age has added psychedelicious drugs and holotopous breathing to research techniques.

Producer
LUCIE SVOBODOVA

Contact
Lucie Svobodova

Factory Art, a.c.
Ovenecka' 15, Praha 7, 170 00
CZECH REPUBLIC
+42.2.422.371624

Three Wishes

This video features special-effects scenes from the motion picture "Three Wishes."

Producer
TIPPETT STUDIO

Director
MARTHA COOLIDGE

Visual Effects Supervisor
PHIL TIPPETT

Contact
PHIL TIPPETT

KC Rosenberg, Executive Asstistant
Tippett Studio
2741 Tenth Street
Berkeley, California 94710 USA
+1.510.649.9711
+1.510.649.9399 FAX
kc@tippett.com

Too Good To Be True

"Too Good To Be True" is a romantic story about two lamps and their after-hour experiences in an antique store where they are on display. No matter how perfect everything may seem, if there is a chance for something to go wrong, it will.

Contact
MICHAEL SPOKAS

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34243 USA
+1.941.359.7574

Transparence

Producer
BRUNO SIMON, RENAULT DESIGN

Director
RENAULT

Graphic Conception
RENAULT

Art Director
RENAULT

Music
GIL SLAVIN

Contact
BRUNO SIMON

Renault Design
860 quai do Stalingrad
92109 Boulogne Billancourt Cedex,
FRANCE
+33.1.46.54.55.56
+33.1.41.04.00.52 fax

Twinkle of Love

Contact
MOON-SUNG PARK

LG Electronics Inc. Corporate
Design Center
36, Munlae-dong, 6-ga,
youngdungpo-gu
Seoul 150-096 SOUTH KOREA
+82.2.630.3235
+82.2.675.4865 fax

Visualizing Time-Dependent Particle Tracing for the V-22 Tiltrotor Aircraft

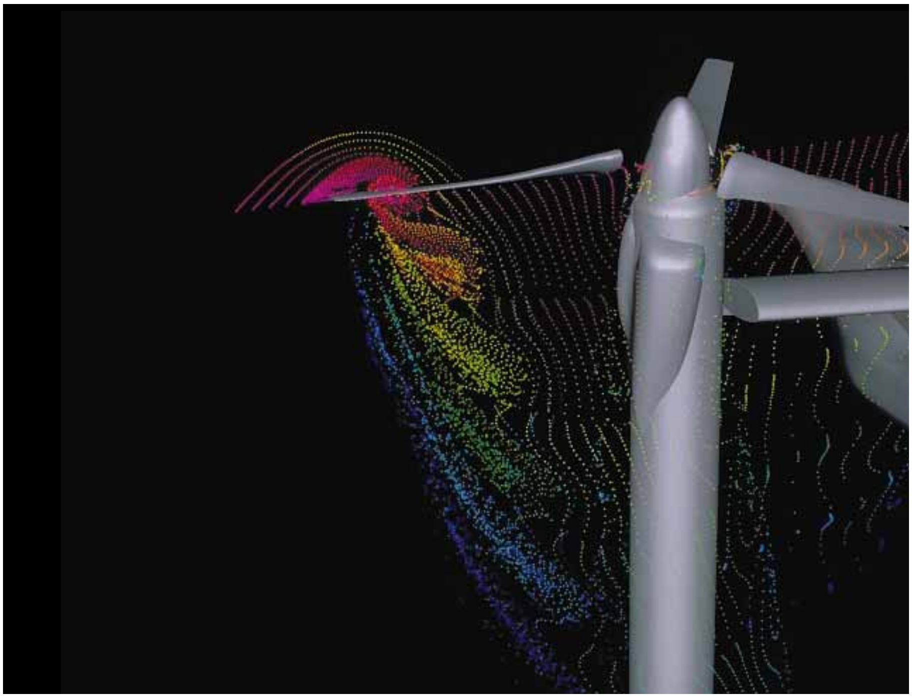
This explanatory video illustrates particle tracing, a flow-visualization technique that is commonly used to study time-dependent computational fluid dynamics simulations. Using a curvilinear multi-zoned grid based on the V-22 tiltrotor, the processes of velocity interpolation, cell search, particle integration, and grid jumping are illustrated.

Producer
MICHAEL GERALD-YAMASAKI

Contributors
MICHAEL GERALD-YAMASAKI, VEE HIRSCH, SANDY JOHAN, DAVID KENWRIGHT, DAVID LANE

Contact
MICHAEL GERALD-YAMASAKI

NASA Ames Research Center
M/S T27A-1
Moffett Field, California 94035
USA
+1.415.604.4412
+1.415.604.3957 fax
yamo@nas.nasa.gov



Walking Around

Producer
JUAN MONTES DE OCA

Scene Artist
CESAR CABANAS

Animation
CESAR CABANAS

Graphic Conception
CESAR CABANAS

Music
SWAN LAKE, TSCHAIKOWSKY, BERLIN PHILHARMONIC

Hardware
SILICON GRAPHICS

Software
WAVEFRONT, EXPLORE

Contact
JUAN MONTES DE OCA

Universitat de les Illes Balears
Cra. Valldlemossa km 7.5
07071 Palma de Mallorca, SPAIN
+34.71.173201
+34.71.173003 FAX

Warashi

Producer
YASUO OHBA

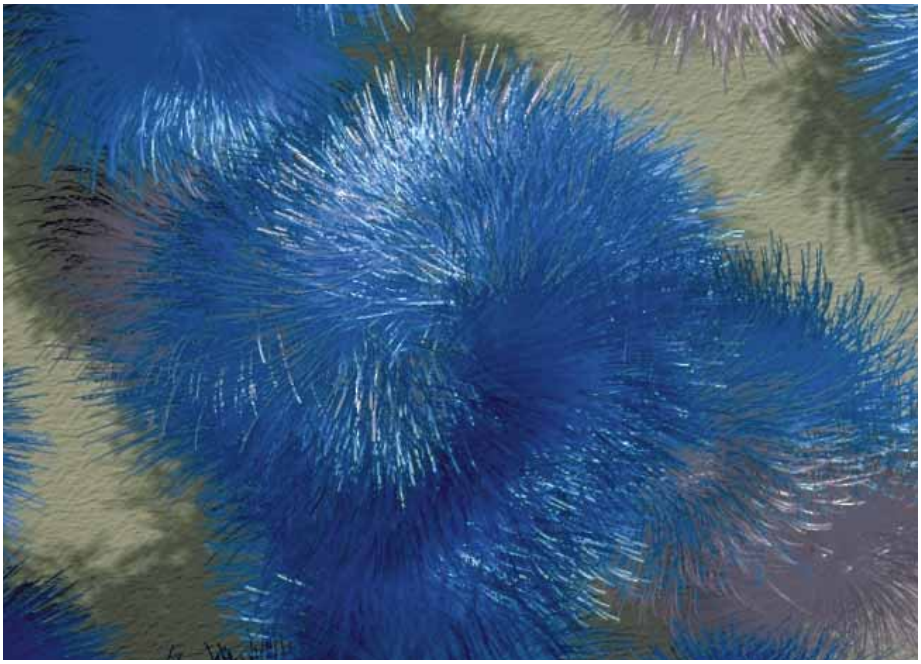
Animator/Technical Director
YASUO OHBA

Hardware
SILICON GRAPHICS INDIGO2 MAXIMUM IMPACT

Software
ORIGINAL

Contact
YASUO OHBA

NAMCO Limited
1-1-32 Sin-Urasima-Cho,
Kanagawa-ku
Yokohama, Kanagawa 221
JAPAN
+81.45.461.8031
+81.45.461.8098 fax
ohba@cg.namco.co.jp

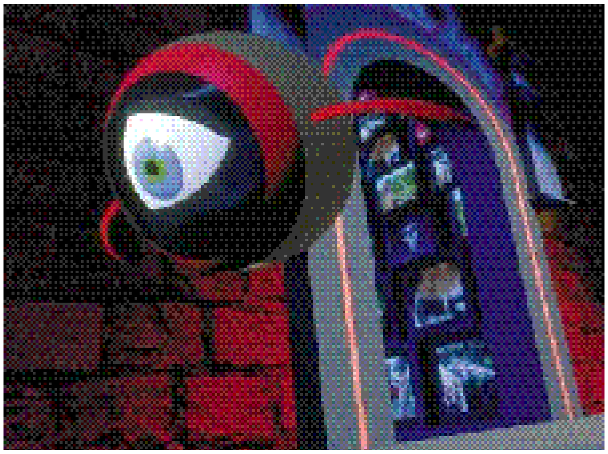


Watch Out!

"Watch-Out!" illustrates how the seductive qualities of TV overpower and entrap innocent viewers.

Contact
JONATHAN WOOD

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34234 USA
+1.941.359.7574



Inline

UNIX / External

Wet Waltz

In this video, a liquid dancer exuberantly spews silvery droplets in all directions. The droplets continue to squiggle and dance on the floor with a zestful life of their own. Motion capture was combined with Xaos' proprietary particle software to animate the liquid character.

Producer
XAOS, INC.

Contributors
MARK MALMBERG, TONY LUPIDI

Special Thanks
INTEL CORPORATION, EARWAX PRODUCTIONS

Contact
HELENE PLOTKIN

Xaos, Inc.
600 Townsend Street, Suite 271E
San Francisco, California 94103
USA
+1.415.558.9267
helene@xaos.com

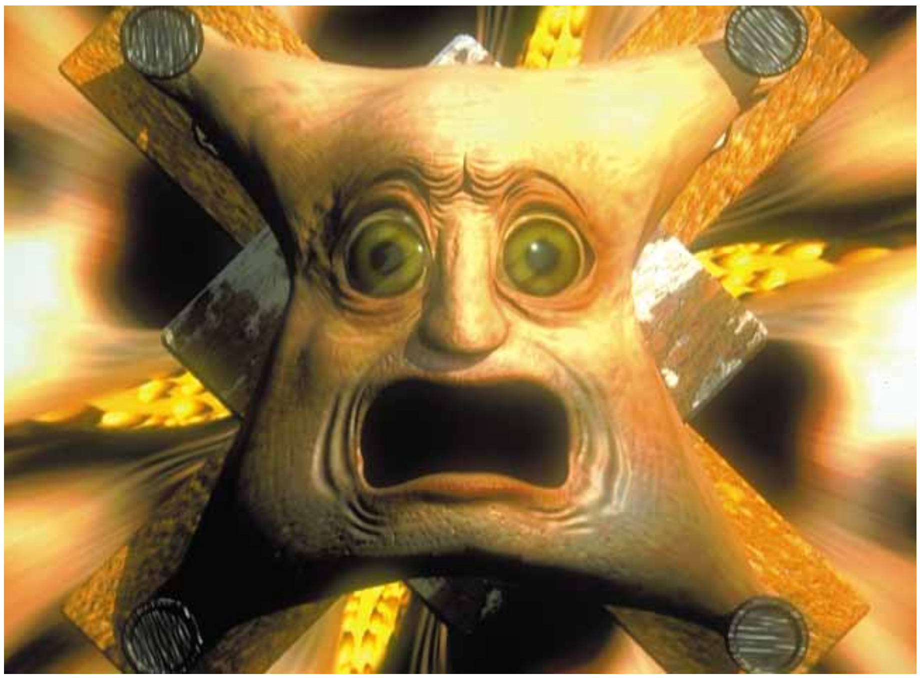
WindEagle

For hundreds of thousands of years, native people lived in harmony with the earth. Yet modern inhabitants of our planet declare dominion over it and treat its systems as marketable commodities, tempting the wisdom to maintain a balance while pulling against our thread of life with nature.

Contact
RICH LARKINS

Ringling School of Art and Design
2700 Tamiami Trail
Sarasota, Florida 34243 USA
+1.941.359.7574

Inline



UNIX / External

Yugi Kyoshitsu: The Play

Rather than fun or cheerfulness, this video focuses on the dismal and brutal side of play.

Producer
HIROYUKI HAYASHIDA

Contact
HIROYUKI HAYASHIDA

Yellow Co., Ltd.
1-34-2 Okusawa Setagaya-ku
Tokyo 158 JAPAN
+81.03.3729.1616

ACM SIGGRAPH

1515 Broadway, 17th Floor New York, New York 10036 USA
+1.212.626.0500 Phone +1.212.764.5537 Fax

SIGGRAPH 96

NEW ORLEANS