

Daniel Keefe, Cavepainter

Forget left and right brain theory, and give serious attention to whole brain ability. Ph.D. student Daniel Keefe is that new breed of visionary inventor that embraces art and science simultaneously. Equally comfortable with algorithms and art, Dan is developing software for tangible tools in the Cave in the Computer Science Dept. at Brown University, while simultaneously working on his own art and collaborating with artists and illustrators at the Rhode Island School of Design.

Article By Prof. Jen Grey (a.k.a. JEN ZEN)

Daniel Keefe is one of the few CGI thinkers in the world committed to continuing research in spontaneous freehand drawing in fully immersive, virtual 3D space. The Brown Cave is an 8' x 8' x 8' four-wall space designed for instant stereoscopic feedback in response to creative action. Dan programs user friendly hand tools as paint brushes, buckets, gloves, and even a force-feedback 3D pencil. The artist can switch a button or touch a brush to a hi-tech palette and VOILA! A tool is set to paint ribbons, tubes, splats, a battery of linear bullets or whatever else Dan's genius can concoct...in any color or texture you desire, at adjustable speeds. An ordinary bucket is adapted so you can throw virtual paint at the walls, enough to make a deconstructive Post-Minimalist scream for mercy. In this world, your body becomes a virtual paintbrush and Jackson Pollock gets credit for serving as a touchstone to a new definition for Action painting.



Dan emphasizes, “Sometimes the hardest thing to get across to people who haven't seen it, is that “CavePainting” is actually 3D. It's NOT at all like real painting. So, the name can confuse people. Just showing 2D snapshots of the models doesn't help with this perception

because the pictures look like 2D paintings. So, it's good to drive home the point that it really is 3D, that you can walk inside each 3D model.”



The experience is emotional, active, kinesthetic, and a LOT of fun. The artist can make imagery that is life-sized, in an ambient, interactive, ambulatory environment. The work is vital because we all know that the big hammer in the digital revolution is that the body is too often a nearly immobile and vestigial remnant of the imagination. No one in their right mind wants to sit in a chair the rest of their life. And Designers want to use their whole body to invent things, without the inherent limitations imposed by all of the currently popular CAD-based programs. Potential future applications include fine art practice and interactive experience in rarified environments, gaming interplay in close or distant overlapping virtual spaces, range of motion training for specialized human or robotic tasks, macro and microcosmic visualization immersion, together with new forms of invention based on touch and motion visualization.

More information, including technical papers, can be downloaded at Daniel Keefe's website.

LIST OF WORKS by Daniel Keefe:

The images accompanying these descriptions are all 2D views of 3D models that are intended to be viewed in an interactive stereo display.

1. Title: Bearded Man

Artist: Daniel Keefe

Date: 2005

Media: 3D interactive “Drawing on Air” model created with a force-feedback, bi-manual paintbrush. Brief Description: This recent work was created with a new generation of tool

we call “Drawing on Air” that is derived from CavePainting and is one of the key technical contributions in my Ph.D. thesis. A force-feedback 3D paint brush is controlled with a two-handed approach to drawing that enables the creation of an invisible 3D force-field canvas. So, as I draw, I can push against this 3D force field to vary line weight (both thickness and color value) of each 3D ribbon of paint. This work is one of the first in a series that explores the potential of this advanced interface for a style of freehand 3D illustration that is far more refined in the smooth paths through space that the curves follow and the richness of the line quality than what is possible with alternative 3D freehand drawing approaches.

2. Title: Swahili Bride with Green Veil

Artist: Daniel Keefe

Date: 2005

Media: 3D interactive “Drawing on Air” model created with a force-feedback, bi-manual paintbrush.

Brief Description: With the additional precision and ability to create smooth arcs through space provided by the “Drawing on Air” interface, I am able to explore a 3D illustration style that uses a small number of lines, a complete departure from normal, smooth shaded 3D surface modeling common in computer graphics. When seen on a stereo computer display, our sense of 3D space is so strong with this model, that our mind is able to “fill in” the negative 3D space and complete the suggestion of the very three-dimensional form of the face despite the minimal use of line.

3. Title: La Guitarrista Gitana

Artist: Daniel Keefe

Date: 2003

Media: 3D interactive CavePainting model in a 4-wall Cave VR display, with sound

Brief Description: The life-sized, 3D model of a Spanish Guitarista rotates in the center of the C.A.V.E., against a backdrop of VR drapery. While the Guitarista rotates in place, viewers listen to a duet on Latin guitars performed by Daniel Keefe and Luis Vega. After a few minutes of viewing, the Guitarista begins to unravel, revealing the CavePainting process in reverse. Each painted stroke is removed one-by-one as the music fades away and the model disappears. The linear scaffolding of the work is revealed as the Guitarista is deconstructed. Eventually, the viewer is left in a space defined only by the virtual cloth on the Cave walls.

4. Title: Sailing a Dhow in Tanzania

Artist: Daniel Keefe

Date: 2003

Media: 3D interactive CavePainting model in 4-wall Cave VR display, with sound

Brief Description: This CavePainting depicts a dhow fishing boat off the coast of East Africa, together with the sound of ocean waves and a Swahili conversation. The dhow rotates inside the space of the Cave as viewers walk around it. Because it is a form of stereoscopic illusion and light, viewers can move through it, and dip their heads under the virtual water. A

deconstructive visualization of the CavePainting process is also a part of this artwork. When the artwork enters the deconstructive programming mode, each individual paint stroke peels away in reverse order of creation, at the same time the whole piece rotates in place to reveal deeper layers of virtual paint.

5. Title: Wedding Day

Artist: Daniel Keefe

Date: 2001

Media: 3D interactive CavePainting model shown in 4-wall Cave VR display

Brief Description: The CavePainted figure grows out of the beach sand. The scene is presented in near life-size, with the beach extending well beyond the 8 foot cube of the physical C.A.V.E..

6. Title: Tunnel Vision

Artist: Daniel Keefe

Date: 2001

Media: 3D interactive CavePainting model shown in 4-wall Cave VR display

Brief Description: The abstract and representational CavePainted forms grow out of the four walls of the 8' x 8' x 8' C.A.V.E. environment. The 3D scene is near life-size, with the some of the VR elements appearing to extend beyond the actual space into deeper illusionistic space.

INTERVIEW WITH DANIEL KEEFE:

How would you summarize your background in art and science?

I was surrounded by art and art-making while growing up. My mom is a printmaker, painter, and art teacher. In college, my painting Professors at Tufts University and the Museum School were wonderful. They inspired me get going as an oil painter. I remember the surprise when I told them I was also an engineering student. That's a reaction I still get a lot. Working with traditional media has had a major influence on my digital work. I love the physical nature of oil painting, and that essence is something I've tried to capture in developing my digital tools.

From a technical standpoint, I have a BS Degree in Computer Engineering from Tufts University. My first serious exposure to computer graphics was a summer job with NASA Langley's Data Visualization and Animation Lab, and I was hooked right away. I loved the combination of art and science, especially the potential to create images that you just can't make in any other medium. Now I am Ph.D. candidate in Computer Science at Brown University, where we have a great virtual reality facility in unique combination with a

graphics group that embraces the idea of incorporating artistic techniques into computer visualization research.

When did you first use a computer? to do what?

I used my aunt's Atari video game system one Christmas; I must have been 4 or 5. I was completely captivated. Later, I took a bunch of my wooden blocks, drew buttons and wires on them, and put them inside an old briefcase. Apparently, I thought this looked just like the Atari. That was my first laptop!

What elements make your current CGI unique? from a technical perspective? and from a personal perspective?

From both perspectives, what makes my work most unique is its hand crafted quality. I want computer graphics to be something people can create with the same sort of physical energy and satisfaction we have when we paint or draw. I feel a connection with painting. It's controllable, but it's free. I can walk around a painting as I'm working on it and feel different emotions. Depending on my mood, I can paint with more or less gestural marks. My whole body is involved in the process, and what comes out is a direct response to my physical movements. So, when I paint I am completely, emotionally and physically connected with the process. That type of tight connection is what I want in a computer graphics tool.

In CavePainting, and in my more recent Drawing on Air system, we are just starting to see this type of connection. From a technical standpoint, this is mostly due to the interaction techniques used in the system. The C.A.V.E. form factor provides a large, head-tracked space that gives you the ability to move around naturally, while Drawing on Air uses a force feedback device to actually create the physical sensation of friction and a pencil touching invisible paper. Tracked props along with body centered, bi-manual and gestural interaction techniques allow you to work quickly and naturally without paying attention to what the underlying computer program might be processing. The algorithms that turn brush movement into virtual 3D form are technically quite simple, but the tight coupling with the artist's movements allows the artist, not the program, to add complexity to the work. When you put all this together in a tool that works for the artist, you can create novel and interesting visuals, particularly of organic and natural subjects - the types of things that are traditionally very difficult to represent with computer graphics.

Are you more an artist or a scientist? What's the difference in what people expect of you?

That depends on the day! Actually, I am never completely one or the other because as a

scientist I study tools for more effective visual communication, and as an artist I make images that rely on my knowledge of science. My scientific research is completely informed by artistic practice, which is what makes it so exciting.

The harder question is what people expect of me. As a scientist people expect results which will continue to advance science. So, the question is does art have a role in advancing today's science? The answer is a resounding YES! As science advances with the ability to collect more and more complex data, scientists have a problem in presenting this visual information in a way that people can understand it. How do we visualize and understand the data? In order for artists to help answer this question, they need to be able to work naturally in the mediums that scientists want to use. We need access to new millennium graphics algorithms and hardware, and we need intuitive, physical control over these techniques at a level that is appropriate for scientific representation. There are so many interesting mechanical questions that remain unanswered in this field; it's an exciting place to be right now.

Which people have most influenced your art and creative process as an artist/scientist? past? present? By choice, or by surprise? Does it show?

My mom, who can find an interesting line in anything organic. My Advisor, Dr. David Laidlaw, has had a strong impact on my scientific outlook and goals while I've been at Brown University. Being in an academic environment, I'm constantly influenced and inspired by the people around me. Artists and collaborators like Bob Zeleznik, Daniel Acevedo, Tomer Moscovich, Steven Schkolne, and Fritz Drury have all been great influences. There's a great culture of collaboration at Brown. I've certainly benefited from it and learned to believe in it.

If all the technology you needed existed, what would you like to make more than anything else?

Outdoor, life-size virtual sculpture. People passing through parks or the woods, maybe even underwater would see it. Initially, you'd have to wear glasses, like sunglasses to see it, but the key is that everyone would have a correct perspective view of the work, so that it fits naturally into the surrounding real environment.

How would it change the world (or does that matter)?

If the technology existed and was widespread, that would certainly change the world, but I hope the work itself is a catalyst for a broader change in how we think about and use the computer. We're just starting to develop computer tools that when manipulated by human hands can produce 3D form that echoes and belongs alongside nature. This work would be about the computer as an extension of the human body. Not in the cyborg sense, but in the

sense that the form that results from using the tool has such a strong link back to the maker. If you look at a nice, hand-crafted wooden boat, you can just feel the maker's hands moving across the surface. Sometimes, this is a subtle effect, but achieving and controlling subtlety is often the grand challenge in computer media. My work is about the tension of human and computer working together and the ability to resolve that tension by refining the computer tool to the point that the artist can work in a physically and mentally natural way. If we can accomplish this, then the visuals that an artist and a computer can produce can be completely different than anything we've seen before.

About the Author:

JEN ZEN (a.k.a. Prof. Jen Grey) presents Computer Generated Images internationally, including recent exhibitions in China, England, France, Italy, Malaysia, South America, Russia, Sweden, and the U.S.A. Prof. Jen Grey teaches Painting and Life Drawing at California State University Long Beach, where she fosters both traditional and experimental methodology. She has received numerous art awards and public commissions, including grants from the California State Legislature, the J. William Fulbright Foreign Scholarship Program, and the National Endowment for the Arts. Her work is featured in *CGI: The Art of the Computer Generated Image* by Peter Weisher, Art Historian, New York University, pending publication by Harry N. Abrams, Inc., New York, New York @ 2004. Jen is currently Co-Chair of the SIGGRAPH-Art Subcommittee of ACM SIGGRAPH Los Angeles Chapter, and top finalist for the Individual Artists Fellowship, supported by the Public Corporation for the Arts and The City of Long Beach, California.

For further information, see:

California State University Long Beach, Art Department Faculty Website.

“Painting in Air” by JEN ZEN (a.k.a. Jen Grey), pgs. 7 – 9, *Members at Large, Computer Graphics*, A Publication of ACM SIGGRAPH, Volume 38, Number 3, August 2004.

Wonderful Article!

This is a wonderful article. Those interested in free form drawing in 3D space might also be interested in the Sonic Wire Sculptor by Amit Pitaru, exhibited (I believe) at the SIGGRAPH 2005 Emerging technologies venue.

<http://www.pitaru.com/>

- Rick Barry