ComputerGraphics World

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The Magazine for Digital Content Professionals

ComputerGraphics World®

January 2004 www.cgw.com

Gollum Rules

The world's greatest CG character extends his reign in Return of the King

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Features

On the cover:
Arguably the greatest CG character ever created, Gollum is among many innovative characters in *The Return of the King*. For more information, see pg. 16.

editor's note

Phil LoPiccolo
Editor-in-Chief

That's Edutainment!

If you've ever played *Math Blaster* or any educational game like it, you know that this genre of software leaves much to be desired. Games such as these simply add shoot-'em-up action to simple drill-and-practice models. Rarely do they take advantage of the computer's ability to create compelling, immersive worlds, simulate complex phenomena, and enable interaction with virtual objects and characters as do many state-of-the-art action/adventure game titles.

"Historically, educational games have been a bit like a spinach sundae—not very tasty and not very good for you, either," says Henry Jenkins, director of MIT's Comparative Media Studies department. That's because a lot of educational games have been made either by educators who don't know much about creating compelling game play or by game designers who distort the educational material, he says. "As a result, most of the 'edutainment' games on the market have all the entertainment value of a bad game and all the educational value of a bad lecture."

But that may be about to change. A new initiative by Jenkins' program at MIT aims to transform the way the world learns through computer games. Called "The Education Arcade," the project aims to employ the latest education research and computer graphics technology to create games that are both educational and fun. So far, more than a dozen proof-of-concept games have been developed, including the following:

***Sole Survivor*:** Earth has been destroyed by aliens. But you have been rescued by rebel alien scientists pledged to preserve the human species. Unfortunately, you are the only survivor. If you help your hosts, they may be able to clone a new human race. This is what they tell you. Should you believe them? You must use your knowledge of psychology to find the answer, because the fate of the human race depends on you.

***Biohazard*:** You're a doctor on a new job in an urban hospital, when you're suddenly inundated with patients who share bizarre symptoms. As an epidemic spreads through the city, you become an agent for the Centers for Disease Control and use your medical expertise and investigative skills to identify the disease and prevent it from spreading, before it's too late.

A new alliance between academia and industry could result in games that are both educational and fun.

***Revolution*:** You are a citizen of Williamsburg, Virginia, in 1773. The threat of war against Britain looms on the horizon. During the next 10 years, you face the toughest decisions of your life. Whether you play a slave seeking freedom, a politician safeguarding the community, a merchant exploiting the war for personal gain, or other roles, you must negotiate the issues of the day with a virtual community of players to determine your fate.

Will these games revolutionize learning? They certainly represent a step forward over traditional educational games, even as prototypes. "Right now, these games are limited by what we can do with a team of undergrad computer science majors from MIT," says Jenkins. "They're interesting classroom exercises, but not the total vision. What's going to tip the scales is if we can engage topflight industry people to bring their skills to bear on building industry-grade games for education."

Of course, breaking into the educational software market will mean breaking down many barriers, such as skepticism from school boards preoccupied with standardized test results. But if game developers are willing to work within such constraints, this could be the opportunity of a lifetime and a worthy goal, which often go hand in hand.

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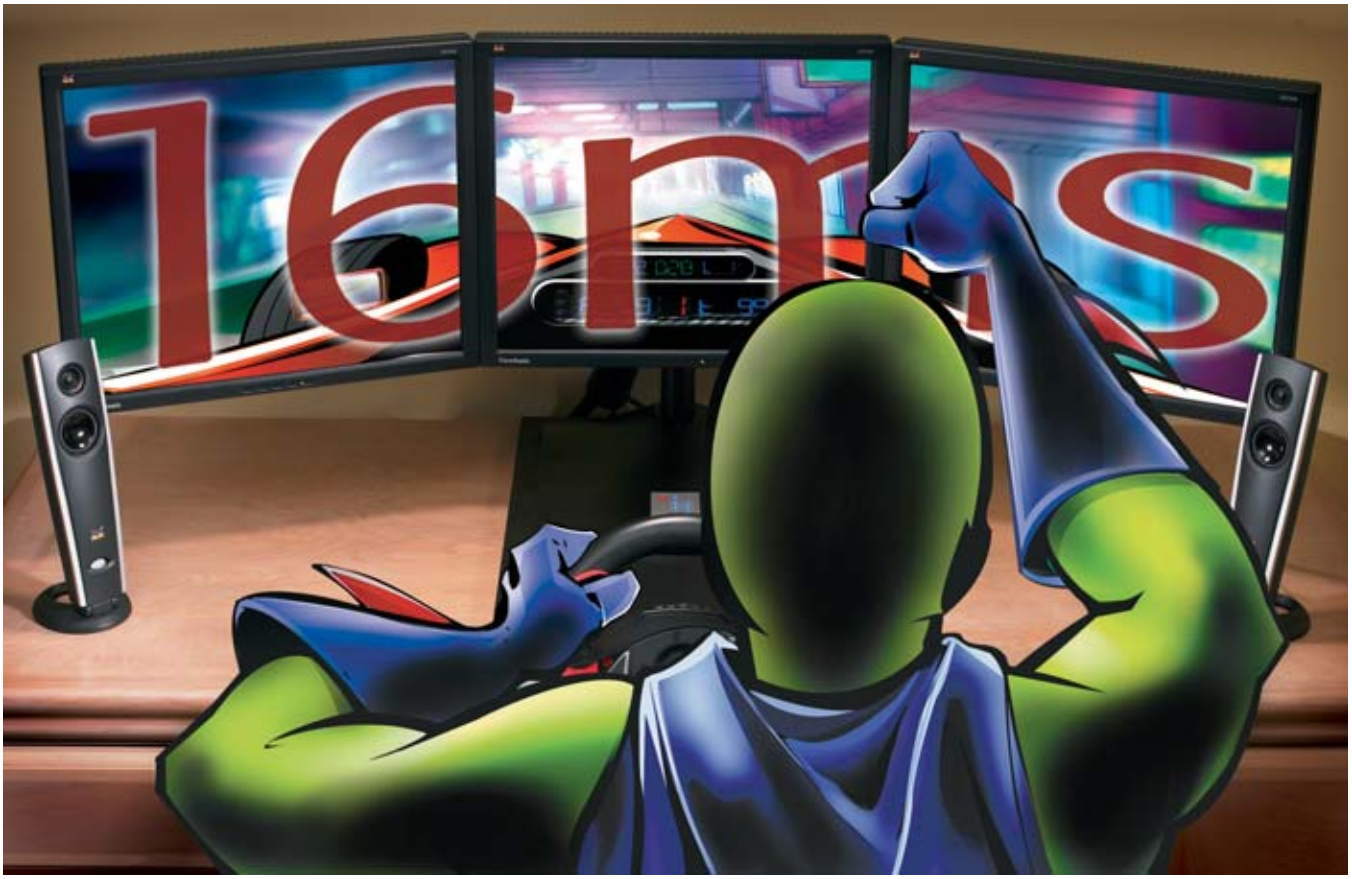

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products | video

Apple Announces G5 Innovations

Apple Computer has introduced several of its latest product releases, including the new Power Mac G5 and G5-optimized versions of its Final Cut Pro, DVD Studio Pro, and Shake.

Apple has amended its Power Mac family with a new dual-processor, 1.8GHZ desktop system. Starting at $2499, the new Power Mac G5 features dual 1.8GHZ, 64-bit PowerPC G5 processors, each with independent 900MHZ front-side buses. The system also boasts a 160GB Serial ATA 7200 RPM hard drive, a 4X DVD-R/CD-RW SuperDrive, an AGP 8X Pro graphics slot, an Nvidia GeForce FX 5200 Ultra with 64MB of DDR SDRAM, and Mac OS X Version 10.3, known as Panther.

At the same time, Apple has released new versions of its Final Cut Pro, DVD Studio Pro, and Shake applications that have been optimized specifically for the Power Mac G5 and Panther operating system. Current users can upgrade free to Final Cut Pro 4.1, DVD Studio Pro 2.0.2, and Shake 3.0.1. Final Cut Pro now offers the ability to play back a maximum of seven uncompressed, standard-definition video streams with real-time effects, whereas Shake is optimized to render up to 45 percent faster on a G5 computer system.

"The dual-processor Power Mac G5 will dramatically speed up all aspects of video creation and management, which in the end saves both time and money," explains Tim Bajarin, president of Creative Strategies Inc. "The increased productivity that more power offers makes this computer an important tool for video professionals. It has raised the bar in computer-aided video creation and management and is now the gold standard for personal computers that will be used in the world of digital video editing." —*Courtney E. Howard*

■ **Apple Computer;** www.apple.com
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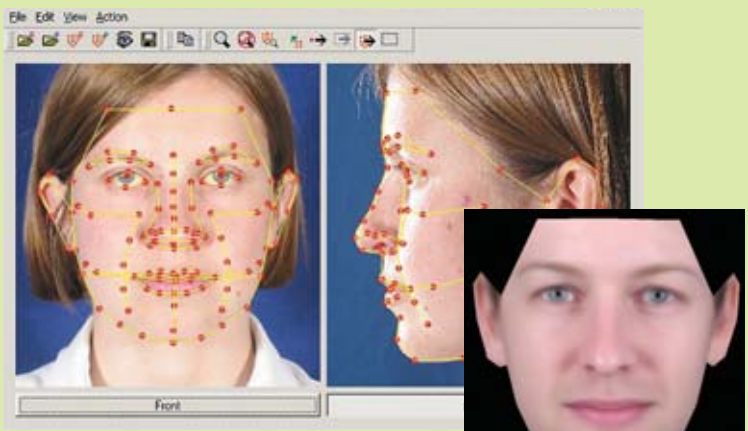
products | modeling

Genemation Unveils GenHead

Genemation has announced the availability of GenHead, its first face-synthesis middleware tool. GenHead is targeted at game developers, as well as professionals in feature-film, postproduction, and Web-authoring markets.

Thanks to its GenePool technology and Face Generation Engine, GenHead speeds and eases the process of creating synthetic, photorealistic 2D and 3D faces and heads. In fact, users can create 3D heads from a photograph for use in a game, for example.



The latest edition, Version 1.1, includes a new Caucasian model from which a wide array of characters can be produced. The upgraded software also boasts improved meshes, enhanced support for Alias Systems' Maya blend shapes, and improvements to the shape of the top and back of the 3D heads. GenHead 1.1 offers the ability to add multiple expressions to multiple identities, and to save them in a batch. —*CEH*

■ **Genemation;** www.genemation.com
infoNOW 100

products workstation

Boxx Launches HD Editing System

Boxx Technologies, maker of digital content creation systems, has premiered the HDBoxx [pro].

An HD nonlinear editing system, the HDBoxx [pro] ships complete with an impressive software bundle, including Adobe Systems' Premiere Pro, Encore DVD, Audition, and a compatible After Effects plug-in for exporting files to Premiere Pro. As well as featuring uncompressed 10-bit 4:2:2 HD, the HDBoxx [pro] sports up to 2TB of RAID 3 storage and 14 hot-swap drive bays in a 5U rack-mountable or desk-side chassis.

Additional features of the HD editing workstation include video genlock sync input, an HD down converter for SD-SDI output, three-point color correction, keyframeable visual effects parameters, and support for 1080i, 1080 PsF, and 1080p. Pricing for the HDBoxx [pro] starts at $18,995 and varies according to configuration. —*CEH*

■ **Boxx Technologies;** www.boxxtech.com
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products video

Matrox Introduces RT.X10 Software Suite

Matrox Video Products Group has debuted RT.X10 Suite, a software bundle combining the company's professional, real-time editing and DVD-authoring platform with Adobe Systems' Premiere Pro, Encore DVD, and Audition.

Carrying a $699 price tag, RT.X10 Suite offers users a variety of options for capturing, editing, and delivering video. The software sports several tools designed to speed work flow, including SinglePass DV scan and capture, the Matrox TurboDV export engine, and hardware-accelerated batch encoding of DVD, SVCD, VCD, and Web formats. Field-blended fast and slow motion, free Web video hosting, and customizable Matrox Flex 3D effects, such as cubes, page curls, spheres, and picture-in-picture, round out Matrox's latest offering. —*CEH*

■ **Matrox Video Products Group;** www.matrox.com
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products graphics cards

Nvidia Card Powers Apple's New iMac

Nvidia has revealed that its GeForce FX 5200 Ultra GPU, also powering Apple Computer's 17-inch iMac, brings cinematic computing to the new 20-inch iMac. The Nvidia GeForce FX 5200 is capable of delivering more than one billion textured pixels per second to ensure smooth game play. The unit also boasts advanced graphics programmability, enabling high-quality special effects. Together with the new Nvidia GPU, the iMac's 1.25GHZ PowerPC G4 processor and 64MB of DDR video memory lend to efficient digital video editing and immersive, photorealistic gaming.

Also new from Nvidia, the Quadro FX 1100 mid-range professional graphics card is incorporated in the IBM IntelliStation M Pro and Z Pro, as well as three new workstations from Hewlett-Packard. —*CEH*

■ **Nvidia;** www.nvidia.com
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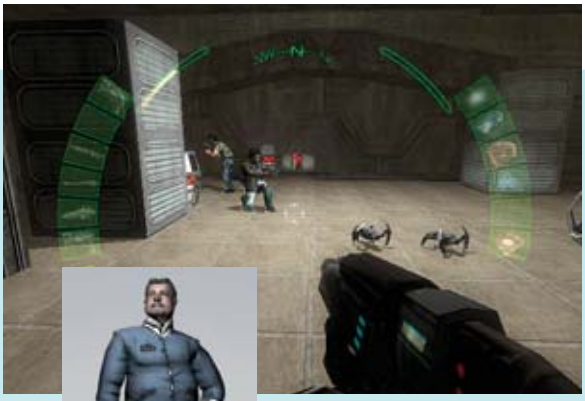
user focus | gaming

The Scope of a Sequel



When *Deus Ex* debuted in 2000, it received 35 Game of the Year awards, thanks in no small measure to its enormous depth and breadth. As game developers at Ion Storm set out to expand the game even further in the sequel, *Deus Ex: Invisible War*, they turned to one of the leading game modeling programs on the market, Discreet's 3ds max.

Deus Ex: Invisible War is a 3D role-playing game in which the player adopts the persona of an elite anti-terrorist agent. In addition to real-world environments—Seattle, Cairo, Germany, Antarctica, and a secret locale—the game incorporates roughly 60 unique character models, hundreds of skin combinations, and a variety of bots and creatures. "One of the biggest challenges was simply the scope of the game," explains Jim Magill, an architectural artist on the game who worked on weapon models, animations, and various game objects. "In a game this deep and long, a huge amount of content must be generated. Luckily, our artists were familiar with 3ds max and were provided powerful plug-ins. We were able to crank out an enormous amount of high-quality art assets on an efficient schedule."

***Deus Ex: Invisible War* boasts more than 60 character models, including Silas Archer (right).**

Ion Storm employed 3ds max to build high-poly meshes, which were textured directly in the 3D modeling program, as well as game objects, weapons, character models, and animation. "Almost everything seen in *Deus Ex: Invisible War* was generated in 3ds max," says Magill, "including mesh detail, characters, weapons, game objects, and HUD elements."

Given the wealth of elements created in 3ds max, it was critical that the software integrate with the company's proprietary game engine, enabling Ion Storm to export content directly to the game. "Many of our proprietary internal technologies were seamlessly integrated into 3ds max via its plug-in system, providing us great control over the content and a quick testing process," Magill notes. "We're all extremely proud of the game. The bottom line is that we simply have a great time playing it, and that's what matters in the end." —*Courtney E. Howard*

KEY TOOL: 3ds max, Discreet www.discreet.com
infoNOW 105

user focus | broadcast

Hip-Hop Appeal with a Comic-Book Feel

Commissioned to create a TV commercial for Lugz shoes, director Arman Matin and his team at RhinoFX were faced with the challenge of developing a CGI style and concept that not only appealed to the urban, hip-hop culture, but also presented the product in a photorealistic vein. Inspired by comic book artists Steve Niles, Ashley Wood, and others, Matin settled on a hyper-realistic, yet painterly spot.

"Our approach was to use CGI to create a dark graphic novel feel," explains Matin. "New York City provided the perfect source for architectural reference, textures, and inspiration. Dramatic angles, strong directional lighting, and deep shadows help to create the feeling." While dense atmospherics and gleaming highlights elicited a dark, wet look, brush strokes applied to color-treated textures and several layers of painted backgrounds added an illustrative quality. "All these seemingly simple processes accumulate to form the final effect."

Creating ShadowFlex, a superhero version of Funkmaster Flex, required numerous iterations in Maya.

Following the creation of a rough storyboard, style frames to establish the look and feel, and literally hundreds of sketches, Matin and his team of 12 artists explored composition, timing, and action in previsualization. "By the time the previz evolved into the final animation, we had completed the layout and texturing for all 27 shots," Matin says. Whereas the architecture was modeled and the cars were accessorized in Alias Systems' Maya, the Lugz shoes were laser scanned and remodeled by hand. Armed with NT- and Linux-based workstations and more than 150 render processors, RhinoFX relied on Maya as its primary 3D package and Adobe Systems' After Effects for compositing. "After a cut lock, we rendered all the CG layers—fog, mist, dust, smoke, cars, background cityscapes, lens flare, volumetrics, shadows, sparks, and other atmospherics. After two weeks of rendering and compositing, we used Discreet's inferno for final color correction and to deliver the spot." —*CEH*

KEY TOOL: Maya, Alias Systems www.alias.com
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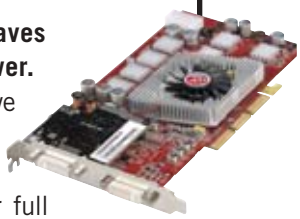
The Power Behind the Pixel



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Tools for Tracking

By Stephen Porter

Executive producer Brian Drewes of Brickyard VFX, a boutique visual effects house in Boston, remembers the circumstances that first brought boujou, a 3D camera-tracking software program from 2d3, into his facility two years ago.

At the time, Brickyard was looking to land a television commercial for Volkswagen that featured one continuous shot in which the camera makes a 360-degree circle around the featured car. The problem was that that shot had been taken the year before, and the current model of the car had different wheel rims. As a result, Volkswagen was considering scrapping the commercial altogether unless Brickyard could find a way to doctor the shot to seamlessly insert CG models of the new rims onto the car.

Even though Brickyard regularly uses Discreet's flame and combustion to perform all kinds of visual magic, Drewes admits that performing this particular trick would be nearly impossible to pull off using their existing camera-tracking capabilities.

Eager to find a solution and win the job, the staff decided to place a call to Oxford, England-based 2d3, which, they'd heard, had a powerful 3D camera-tracking program called boujou. "We told them we have this scene and we'd like to see if they could track it," recalls Drewes. "We told them that if they could get the track and we got this job, we were going to buy boujou. They tracked it very quickly and sent it to us, and we were very happy with the results. The track was perfect. And that one job paid for the cost of the software."

Brickyard VFX relied on boujou to create a long pull-out shot for a joint Volkswagen Beetle/Apple iPod commercial. The software helped Brickyard create a seamless shot in which the camera moves from a close-up of the iPod to a view of the car from high above.

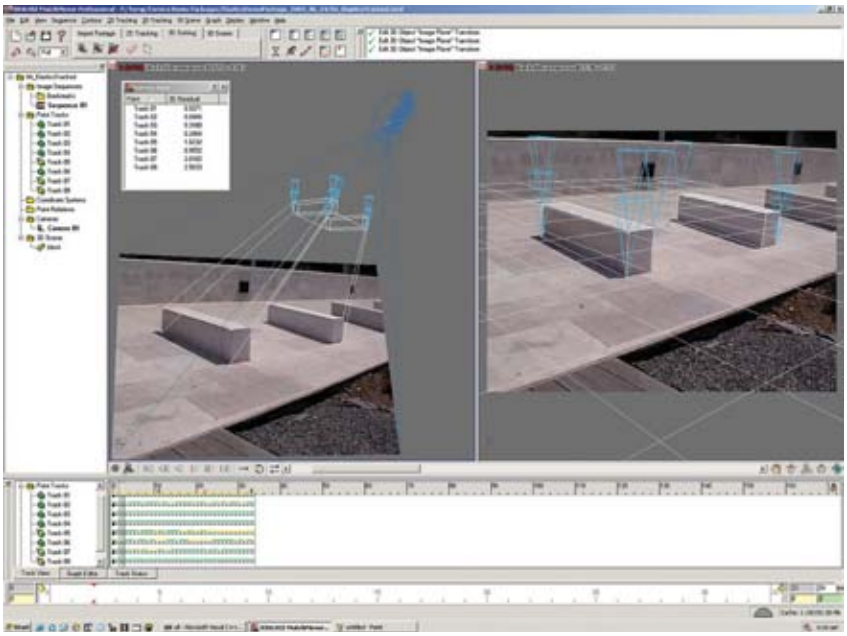
Since then, Brickyard has used boujou on several occasions, most recently for another Volkswagen commercial promoting a cross-marketing campaign with Apple. This commercial featured another continuous camera movement that started with a close-up shot of an Apple iPod located inside a Volkswagen Beetle, and then rose skyward through the car's sunroof. Although it might look simple, it proved to be a complex shot that required the use of numerous composites and boujou's camera-tracking capabilities. "Without boujou," says Drewes, "we would have had to spend a lot more time tracking by hand."

While an increasing number of compositing programs are beginning to offer motion-tracking functionality, including such low-cost applications as Adobe After Effects, these capabilities tend to be limited to point trackers, which are useful for tracking 2D objects in a scene. Yet, 3D camera trackers offer significantly more sophisticated capabilities due to their ability to track objects and camera moves in 3D space.

"Point trackers have no knowledge of the camera, so they cannot help you when the object you are tracking goes out of a shot or behind something else in the scene," explains Chris Steele, CEO of 2d3. "Because boujou builds a knowledge of where things are in 3D and the way the camera moves, it knows where things are and how they are moving in 3D."

Stephen Porter is a contributing editor of *Computer Graphics World* and a freelance writer who covers video, graphics, and digital content creation technologies. He can be reached at sporter@gsinet.net.

The latest camera-tracking tools aid in unique and innovative shots.



Pixel Magic uses RealViz MatchMover Professional for a variety of visual effects shots. At left, the software is checking the 3D coordinates of CG objects inserted in a scene in *DareDevil*, in which the title character balances on the ledge of a building.

Whether the job requires adding CG rims to live video footage of a car or adding a virtual character to a battle scene in a movie, camera-tracking software can ease the task significantly. "The technique is used a great deal for extending sets or for ensuring that shots have correct historical detail," notes Steele. "Often it is used for adding props that were not constructed in reality."

Only a handful of vendors specialize in 3D camera-tracking software, and 2d3 is one of the market leaders. Its long list of customers includes such effects houses as Dreamworks, The Orphanage, Ring of Fire, and The Moving Picture Company. According to Steele, boujou's competitive advantage is that it is built upon an architecture specifically designed for automatic processing.

Automatic vs. Manual Tracking

While 2d3 points proudly to boujou's

automated features, another leading player in this market takes a different stance. Like 2d3, RealViz also hails from Europe, specifically from Sophia Antipolis, France. Its offering in this market is MatchMover Professional 3.0. And if there's one thing the company's most proud of, it's the software's ability to handle complex tracking problems through its manual controls.

Jason Baker, motion tracker at Framestore CFC, a London-based effects facility, relied heavily on MatchMover to create scenes in the recently released movie *Underworld*, which featured humans transforming into werewolves and vampires. "A number of other matchmoving packages are available, each with its own strengths and weaknesses," he says. "MatchMover's strength is in providing the user complete control over every aspect of the tracking process.

"I tend to use MatchMover for shots that require a lot of manual intervention, in other words shots that cannot be easily tracked automatically," Baker adds. "These include shots that are very motion-blurred or have a lot of objects or people obscuring the features you wish to track. I also would use it if I was provided with a very accurate set of survey data (scans and marker positions). This additional information can be entered easily into MatchMover to give a much more accurate solve."

Rounding out Europe's monopoly on the camera-tracking business is Science-D-Visions, which hails from Dortmund, Germany. A pioneer in the market, the company offers 3D-Equalizer (3D-E), which has been around since 1996 and was awarded a Technical Achievement Award in 2001 from the Academy of Motion Pictures Arts and Sciences for its contribution to "surveyless tracking."

Used extensively in feature filmmaking, 3D-E has played an important role in the making of various movies, ranging from *The Phantom Menace* and *Gladiator* to *Spiderman* and *Lord of the Rings*.

Matt Mueller, the senior camera technical director for Weta Digital, the New Zealand-based effects facility that has been dazzling the world with its work on the *Lord of the Rings* trilogy, is among those who speak highly of 3D-E. "Our camera department relied heavily on 3D-Equalizer for complex camera solutions and object tracking for over 500 shots on *The Two Towers*," he says. "3D-Equalizer's speed, flexibility, survey import, and new auto-tracking features made difficult shots manageable. 3D-E addressed all of our needs while in production and enabled us to complete work which would not have been possible with other software."

With glowing comments like this coming from the users of all three leading camera-tracking programs, it may take some time and testing to determine which program will best meet users' particular needs. But they can take comfort in knowing that the once-arduous task of marrying computer graphics to live film or video footage has become considerably easier.

The Big

The bold attempt to film J.R.R. Tolkien's epic fable of Middle-earth has been a resounding success. Already, the first two films in director Peter Jackson's rousing *Lord of the Rings* trilogy from New Line Cinema have become classics—very successful classics: *The Fellowship of the Ring*, with its Hobbits, wizards, elves, and Orcs, generated $862.2 million in box-office revenue; the second film, *The Two Towers*, topped that with ticket sales of $920.5 million, putting it into fourth place among all films, of all time. Both movies count nominations for Best Picture and Best Director among their 13 Oscar bids, and the films have won six Oscars, including two for visual effects. Many pundits bet Jackson will win an Oscar for Best Director this year, some think the third film, *The Return of the King* released on December 17, will be in the running for Best Picture, and most believe the crew will take home a third Oscar for visual effects.

It would belittle Jackson's grand accomplishment to call these sagas "effects films." Yet without visual effects, both practical and digital, we wouldn't have seen, in the first two films, 10,000 Orcs attacking Helm's Deep, Gandalf fighting a fiery Balrog, Gollum leading Frodo and Sam to Mount Doom, or an army of Ents high-stepping out of a forest. Nor, in *The Return of the King*, would we watch 250,000 Orcs, thousands of horsemen, and mammoth Mumakils trumpet their way into battle, Gandalf fly on the wings of an eagle, and Frodo, Sam, and Gollum wrestle near the lava of Mount Doom.

In terms of effects, it turns out that the first films were a dress rehearsal for the third, which has more effects than the first two combined. "It probably has around 1800 visual effects shots," says Jim Rygiel, visual effects supervisor. "I figure we're pushing an hour and a half to two hours of

Weta Digital revives Gollum (aka Sméagol) for The Return of the King and sends thousands of CG Orcs, horses, and giant creatures to battle.

By Barbara Robertson

and the Sméagol

effects." Weta Digital in Wellington, New Zealand, created 1500 of those shots—twice the number the studio created for the second film (750), which was nearly twice the number of the first (400).

Among the 1500 shots are scenes with Gollum, creatures new and old, digital environments, and procedural simulations. For each, Weta developed innovative and efficient techniques—some involving major changes, others more a matter of fine-tuning.

"We knew the volume of shots we'd have to do," says Joe Letteri, visual effects supervisor at Weta. "At the end of film two, when Peter [Jackson] decided to flood Isengard, we had to fly by the seat of our pants. This time, we had a system in place, so if we needed to stage something that didn't exist, we'd be ready. Also, we hammered on the pipeline and got all the things we needed working to the point where the technical side was transparent and people could just use it. By setting up the pipeline with a lot of standards in mind, we could pull people in from all over the world." Indeed, the studio grew from 150 people on the first film to around 420 at the height of production for the third, with 20 compositors brought in during the final 10 weeks.

Weta's pipeline is based on Alias Systems' Maya for modeling and animation, Pixar Animation Studios' PR RenderMan for rendering, and Apple's Shake for compositing. In addition, Massive Software's Massive handled procedural animation for crowds, Jon Allitt's Grunt rendered the crowds, and Giant Studios' Giant software was used for motion capture. The programs ran on Linux-based Intel machines with a total of 3500 processors at last count.

Although Weta created digital environments and set extensions for *The Return of*

Weta adjusted the lighting for Gollum's eyes, changed his hair simulation, and slightly altered his model for this film (below). For the battle at left, the studio procedurally animated armies of digital characters.

the King—notably Sauron's tower, a digital structure that breaks apart and collapses with the help of software developed in conjunction with Tweak Films—most of Weta's work centered on creatures and characters. "A big chunk of the film is the Pelennor Fields battle, where we have digital Mumakils attacked by digital riders on digital horses who are attacked by digital Orcs coexisiting with practical horses, riders, and Orcs," says Rygiel. "Peter [Jackson] brought back all the digital characters except Balrog and the Watcher." Gollum, of course, plays a major role.

Filming Gollum

As before, Gollum's performance is based on that of actor Andy Serkis, with animators at Weta again using a mixture of motion capture, roto-motion (matching animation to a live-action plate), and keyframe animation.

For this film, the motion-capture team developed an onset capture system, arguably the first use of motion capture during principal photography and an innovation that will likely have a major effect on filmmaking. "It was particularly useful when Andy [Serkis] had to tumble down the hillside as he's fighting with Frodo [Elijah Wood]," Rygiel says. "As they're tumbling down, we're motion-capturing Gollum in real time."

Previously, the crew would film a scene with Serkis wearing a blue suit so that he could be easily replaced with Gollum later.

Gollum's facial expressions were hand-animated, but for his performance, animators often used motion-capture data from actor Andy Serkis, who also provided Gollum's voice.

Then, they'd bring Serkis onto a motion-capture stage and try to match the earlier performance. Lastly, once Serkis was painted out of the shot, the motion-editing team, matchmovers, and animators would fit Gollum into the scene. But, because Serkis's performance in the motion-capture studio never quite matched his performance on the set, the process was arduous.

By contrast, with onset motion capture, the markers were on Serkis's blue suit when Jackson shot principal photography. "When Gollum is fighting with Frodo and Sam on Mount Doom, you believe the character is there, pulling their shirts, hitting, punching, choking," says motion-capture supervisor David Bawel, "because he was." Bawel led a 10-person motion-capture team (that grew to 15-plus when capturing Serkis) and a 15-person motion-edit team that together produced animation for Massive agents (characters used in the procedural crowd simulations), horses, and digital doubles, as well as for Gollum.

Once available, the onset motion-capture system found other uses. "We put markers on Elijah and Sean (Astin, who played Sam) so when they had to push Gollum or pick up objects that were not real, we knew where in space these points were relative to the camera," Bawel says. "We also tracked cameras and objects that we'd normally have to track off the film plates. It's a step forward that I'm confident will continue in the filmmaking process."

Although Weta used Giant's system on its large motion-capture stages for all three films, making onset motion capture possible for the Mount Doom sequence were new cameras and infrared light sources developed by Motion Analysis. The cameras' onboard computers and single cable simplified setting up a system on a sound stage; the new light sources were invisible to the film cameras, yet strong enough to keep the motion-capture cameras at a distance and out of the way.

The team's portable system held 16 cameras in an array on a truss above the sound stage, positioned so that the cameras could track any object within the set. The 1.3 million-pixel-resolution cameras caught the action at 60 and 120 frames per second, although they could have captured at a faster rate, according to Bawel.

"Because Gollum and Andy are built differently, the motion capture required some adjustment," says Randall William Cook, animation supervisor. "But much more of Andy's movement is guiding Gollum in this film than in *The Two Towers*."

For Gollum's face though, as in *The Two Towers*, animators used Serkis's performance only as reference, creating facial expressions with keyframe animation through a Maya-based facial control system and a library of expressions. "In shots where Gollum had no dialogue, the animators would write out precisely what Gollum was thinking on every frame, and then act out his internal dialog without moving his lips," says Cook. "We had to fool the lie detector of the movie camera into believing Gollum was really thinking, not pulling faces."

As for Gollum's physical self, the crew made subtle improvements to the now well-known character and also created a second, emaciated version of his model for some shots. For *The Two Towers*, to make Gollum's skin look like flesh, Weta wizards assembled a witch's brew of techniques, including a subsurface scattering shader written by technical director Ken McGaugh, texture maps for surface details, specularity, and shadow maps for ambient occlusion. "We stuck with what we were doing, although Ken added a little raytracing to increase the level of detail in the ambient occlusion," says Greg Butler, sequence supervisor for Gollum. "Also, after film two ended, Steve Upstill began working on Gollum's eye shaders. The lights were tuned to Gollum's skin, and when we threw lights on his eyes, we didn't get back what we expected. Steve gave us more control."

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To gain greater command over Gollum's hair, the team switched from Maya's cloth and fur tools to Sylflex plug-ins for Maya. "Now, we can make individual adjustments to every hair," says Butler.

As for basic structure, other than modifying Gollum's knee and elbow shapes and reshaping his calves, his model, which was switched from NURBS to a subdivision surface model during film two, was left largely unchanged.

Building Characters

The same can't be said for the other digital characters. All but Treebeard were remodeled and updated. (They left the giant tree's 2200 texture-mapped NURBS patches alone.)

"Some creatures were never meant to get close to the camera or perform motions as complex as needed for this film," says Letteri. "But the biggest change was that we applied everything we learned from Gollum to the creatures."

The major modeling change adopted from Gollum was the switch from NURBS to subdivision surfaces. "The success of subdivision surfaces was so significant, we rebuilt all our creatures and digital doubles from scratch," says Matt Aitken, digital models supervisor. "It was like starting from a clean slate."

Also, the effects teams added lighting and rendering techniques honed on Gollum to all the creatures. "Everything has subsurface scattering now," says Guy Williams, CG supervisor, "even the trolls." In addition, the dragon-like Fell Beasts and elephant-like Mumakils received special attention, and the eagle Gwaihir had its feathers unruffled.

In one scene, nine of the dark Fell Beasts, each with a digital Ringwraith on its back, black cape flowing in the wind, fly out of the clouds and over the white city of Minas Tirith. Although the Fell Beast was first created in preproduction before *The Fellowship of the Ring*, because the camera moves close in this film, the team improved its look. "Most of the focus on the Fell Beast was on writing new shaders, simulating the effect of wind on the wing membranes, and adding more details to the textures," says Jean-Colas Prunier, lead technical director. "Its skin was covered with scales that needed to be iridescent." To light the beast, which measured around 98 feet from wingtip to wingtip, the crew used a combination of shadow maps and shaders that utilized the new ray tracing features in RenderMan 11 to create subsurface scattering, ambient occlusion, and for part of its wings, a particularly diffuse translucency.

"Working on this creature was like doing archeology," Prunier says. "One texture layer was four years old; another was painted by someone who worked here two years ago. The history of the production on these three films was in this creature."

To add lightweight geometric detail to the creatures' surfaces, the modeling team shipped maquettes to XYZ RGB for scanning with a 3D scanner from Arius3D. Modelers then built a subdivision mesh on top of the scan and extracted the difference between the heavy scanned mesh and the lighter subdivision mesh as a displacement map that was applied to the subdivision surface at render time. "It's a great way to preserve geometric detail without clogging up the 3D pipeline," says Aitken.

The team also began using a software-based method for adding geometric detail. "We've been working with the developers of ZBrush [Pixologic] to develop a pipeline so we can paint detail rather than using scans," notes Aitken. "We were using it routinely on models that didn't start with scans—painting muscle shapes onto the surface of the horse, adding detail to props, such as weapons."

Close-up shots of the eagle Gwaihir, on the other hand, presented a different problem. "We needed a new approach for digital feathers,"

The Fell Beasts at left and below were switched from NURBS to a subdivision surface model, as were all the creatures except Treebeard. In addition, new shaders were written for this creature's close-up.

The evil, spider-like Shelob, one of the few new creatures in the film, had three kinds of skin plus bristly hair. The shader used to render it was 2000 lines long and had 20 illumination models.

says Aitken. "We got to the point where we could build feathers and keep them from interpenetrating, but after each of the feathers moved away from the next one, the bird looked like it had had a terrible fright." Finally, Aitken decided to turn the puffy bird into a sleek eagle by ignoring interpenetration. "I remembered an old algorithm called the painter's algorithm, which deals with hidden surfaces by rendering everything in the order of distance from the camera," he says. "It paints over surfaces already rendered. It had been taken out of RenderMan because no one was using it, so we had to trick RenderMan to do it." Thus, the eagle was rendered from tail feathers to head, feather after feather on top of (and hiding) the previous one. "It works because the feathers have a fundamental order," says Aitken.

Among the new characters in film three were "great beasts"—created during the last month of production to pull a battering ram during the battle—and, more important, Shelob, who attacks Frodo and Sam in two sequences that total about seven minutes. "She is a spider, but not like any spider you've seen," says Williams. "She's truly evil. Every part of her looks repulsive or painful to touch."

Working from an animatronic built in the Weta Workshop as reference, the digital effects team built the creature with three kinds of skin: a shiny, purple plastic surface designed to scatter highlights, a soft flesh-like skin for its mouth and belly, and leathery skin. Using techniques learned from creating Gollum, the team layered materials such as dust, dirt, and slime inside the shader. "The shader was probably about 2000 lines long," Williams says, "with 20 illumination models inside it." Shelob's complex, eight-legged rig included controls for every joint and for the back so that animators could squeeze the body through holes.

Of all the creatures, though, the Mumakil was perhaps the most complex. Twenty-one of these 40-foot tall, tusked, elephant-like beasts with wicker towers on their backs holding 50 archers show up during the third phase of the big battle. Trained to stomp, maim, and mangle their opponents, the creatures are so immense that in some shots we see only a foot or a leg. "It was a nightmare-modeling scenario, building the Mumakil and the tower with rope, cloth, canvas, and skins and then rigging the tower for dynamics so that as the creature walked along, the tower swayed and creaked," says Aitken.

The battle of Pelennor Fields takes place on a digital canvas created, in part, from photographs taken of New Zealand's South Island by set director Alan Lee. "We had to follow the main characters through the battlefield, and it was such a fluid mixture, we had to previz pretty much the whole battle in a low-res form," says Rygiel. "Peter would sit in a virtual set and direct Mumakils and horses."

War Stories

The battle begins when 250,000 Orcs and a pack of dog-like Wargs lay siege to Minas Tirith. The Orcs are attacked by 6000 Rohans on horseback who are, in turn, attacked by the Mumakils.

The Massive software program developed by Stephen Regelous and used for the previous films handled the Orcs and other warriors, the horses and horsemen, the people riding the Mumakils, civilians around Minas Tirith, and an army of the dead. "The software has moved so far since film one," says Eric Saindon, sequence supervisor for Pelennor Fields. "It has support for an arbitrary number of cameras so we can run one big simulation, and then use it for several shots from different angles. And, it has full cloth solves, so we get a lot more motion from hair, skirts, and horse manes and tails."

In addition, Massive agents could maneuver on animated terrain, which helped the archers in the Mumakil towers adapt to the moving platform beneath, and later in the film, helped Orcs run on ground opening up beneath their feet.

While the archers in the Mumakil towers were sometimes Massive agents, sometimes live-action actors composited in, and sometimes digital doubles, the Mumakil itself was animated by hand. "It was a huge undertaking," says Cook. "We used a number of tricks to make its skin slide, and shot sculpting to make the muscles, fat, and bones all behave appropriately on this big thing."

For the riders and horses, Massive supervisor Jon Allitt relied on one Massive agent brain for both horse and rider. "We had a motion tree for each kind of rider, as we did for any agent, with maybe 200 actions, plus another motion tree for the horse," explains Allitt. "The horse motion tree controlled where it went on the battlefield, and the rider would react to the horse, leaning appropriately as it went downhill or uphill or turned. Because it was all in the same

Digital Mumakils (at right) are attacked by digital riders on digital horses who are attacked by digital Orcs coexisting with real horses, riders, and Orcs in the great battle (above).

brain, the horse could tell what the rider was doing, and the rider knew what the horse was doing."

To move on the battlefield, the horse would "listen" to other agents on the ground. "For example, when the Rohan are charging a line of Mumakil, they have to react to the Mumakil's feet and to the arrows from the Harad in the towers. So, we parented agents that emitted a sound for each foot that helped the horses determine how close they were to the enormous feet." To render the thousands of characters that moved through the Massive pipeline, the crew used Allitt's Grunt, written specifically to handle crowds of animated characters.

Most of the 6000 horses were digital with animation often based on data from real horses that were motion-captured using the Giant system on a 60-by-20-foot stage. "We had horses running, cantering, and being attacked by creatures and characters with weapons," says Bawel. "Some of the data was for specific shots, but most was used for Massive crowd animation."

About 200 of the horses were real. Some were filmed in front of a 600-by-60-foot bluescreen; 20 were filmed by Rygiel with a handheld camera while riding in a car. "We spent a month figuring out how to track those cameras," says Saindon. "And then we did lots and lots of rotoscoping."

The digital horses are intermixed with live-action horses; Orcs and Mumakils are mixed in with all of them; and they all interact with each other. "You really feel like you're in the middle of this battle with giant elephants around you," says Rygiel.

The most spectacular shots in the battle might be the scenes of Legolas (Orlando Bloom) jumping on a Mumakil. For this, the modeling team ordered special high-res scans of the Mumakil maquette. Bloom was filmed on an "elephant rig" on a bluescreen set, and Cook's team augmented that motion with an animated digital double.

To help push such complicated battle shots as these through production, Saindon's team would pick key shots for various sequences and finish those first. "It was a little scary," he says. "With three weeks left in the schedule, we had more shots to do than we had total shots for the first movie."

End of an Epic

Among the final shots were those of Mumakils crashing together in the battle, the Fell Beasts with reflections of fiery explosions in their scales, shots at Black Gate where the earth opens up under the Orcs, and Gollum's death scene.

Although many people on the team will stay to work on the DVD, and some have signed on to work on new films, for others, the end of production on *The Return of the King* means the end of their own "fellowship." "Many people thought this was a mad quest at the beginning," says Cook, who started working with Jackson on previsualizations for the first film. "They thought such an effects feat couldn't be achieved anywhere, much less in a little backwater part of the globe. It's taken a huge collaboration of talents to achieve this impossible dream."

Adds Rygiel: "People were really into working on the show, not just their little part of the show. We settled in for the long haul. The first time I saw the scene at Gray Havens at the end of the film where the hobbits have to say good-bye to the people they love, I got tears in my eyes because I realized this was the end of the film for me, too. We've reached the end of all three films now. It's pretty amazing. There's no more of this."

Barbara Robertson, a contributing editor for Computer Graphics World*, writes about computer graphics, animation, and visual effects. She can be reached at BarbaraRR@comcast.net.*

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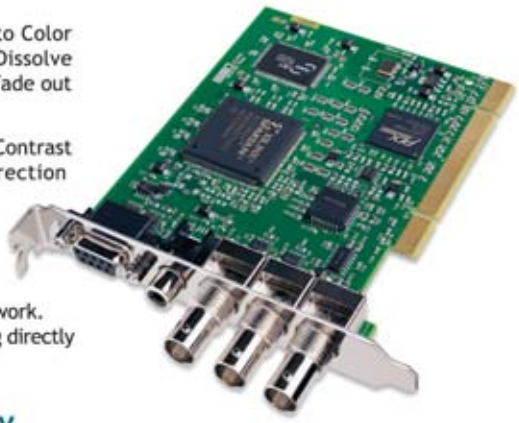

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Hat Tricks

With Rhythm & Hues handling the bulk of the work, seven studios use CG tools to shape storybook effects for The Cat in the Hat

By Barbara Robertson

Dr. Seuss created storytelling history with his magical little book, *The Cat in the Hat*, which, famously, uses only 220 words to tell the absurd tale of a mischievous cat that shakes up the house for two bored children on a rainy day, and then cleans up the mess before Mom comes home.

By using a combination of physical sets and visual effects, the production crew for Universal Pictures' live-action adaptation of *The Cat in the Hat* created a setting for an expanded story that included a Seussian neighborhood of 23 houses built on 14 acres in Simi Valley, California, a flashy car for the Cat, and a wildly transformable house. To help stretch these real-world elements further into fantasy, producer Brian Grazer and director Bo Welch assembled a visual effects crew under the direction of visual effects producer Kurt Williams. Seven studios helped create 650 visual effects shots, nearly half the running length of the film, with the majority of the work going to Rhythm & Hues (R&H), whose Doug Smith was the visual effects supervisor of record for the film.

"This movie has everything from the most difficult 3D work that exists to tried-

Actor Mike Myers in cat makeup (left) and the houses (right) are real, but the sky, the curlicue clouds, and the saturated, storybook colors were created digitally by various studios.

The purple goo was formed by a crew at Rhythm & Hues with blobbies and a voxel noise field in Houdini and vMantra using the film's specific color palette.

and-true simple compositing," says Williams. "The most important role of the visual effects was to create a world that was based on our world as seen through a child's eyes. The houses look like houses a child would draw. The clouds are swirled, the colors are saturated, and the color palette was very specific."

"I know some new tricks," said the Cat in the Hat.

In the book, the Cat and two impish Things he brings in a box turn the children's house upside down and inside out, much to the dismay of a talking goldfish. In the film, as in the book, after Mom leaves the kids home alone, the Cat appears to cause no end of trouble; the Things arrive in a box; and the fish also talks. But in the film, there's a little extra adventure as the Cat (played by actor Mike Myers) and the kids chase through the neighborhood after their dog. Inside the house, a crate releases a purple tornado. And, the house isn't simply destroyed; it's twisted into wild shapes and turned into a strange and distorted world. "It's a little like a combination of Monument Valley and Disneyland over the top of an ocean in pinks and purple," says R&H's Smith. "But even though the images were strange, they had to feel real."

In addition to creating matte paintings and 3D structures for the distorted house, R&H's 300-some shots included the talking fish and digital doubles for the child actors who played the Things. "We had a wide range of effects," says Christopher Sjoholm, digital effects supervisor, "from bluescreen out the window shots to extending the road in the neighborhood to make the environment grander, but the most difficult were the 3D effects: the fish, the water in the fish bowl, and the tornado sequence that comes out of the box toward the end."

"Put me down!" said the fish.

With the exception of the lock on the box—a crab created and animated at Stan Winston Digital—the fish is the only animated character in the film, and the only one that talks. "The director wanted the fish's performance to be based on the Barney Fife character in Mayberry," says Smith, referring to the bumbling deputy played by Don Knotts on *The Andy Griffith Show*. "But the fish doesn't have any lips or cheeks, so all the emotion had to happen in its eyes, in the wrinkles between the eyes, and in the general body posture."

The fish was modeled and performed with keyframe animation in R&H's proprietary Voodoo software using magnets and deformations, according to Sjoholm. "We try to stay away from blend shapes except for specific poses, like when the forehead is most wrinkled," he says, "because it mooshes up the image."

Even though the fish is in only approximately 40 shots, the over-the-top, passive-aggressive character has an important role. "He fills out the ensemble for the film," says Williams. More a humanoid character than a fishy fish, he's usually partly out of the water and often standing up or slightly bent when delivering dialog, so the animators didn't have to worry much about making him swim correctly. On the other hand, having a character half in and half out of water in a glass bowl in a live-action scene meant the rendering crew needed to pull some tricks out of its hat. And the water in the bowl, which was nearly always CG, had to look and act absolutely real.

"The fish had to be lit for three different environments—above the surface, through the glass, and through the glass and the water—and it would move from one to the other or be in all three at the same time," says Sjoholm.

On the live-action set, the crew used a rig with two back-to-back cameras that had 180-degree lenses to capture 360-degree HDRI (high dynamic range image) photos for shots that would include the fish. Later, using ambient occlusion techniques, they applied colors from the images as they rendered the fish's skin, helping it fit neatly into the environment. They also used subsurface scattering for the fish to help make the character's skin look somewhat translucent. "The lenses of the fish's eyes even had refractions in them," says Smith. For rendering, the crew used Wren, R&H's proprietary renderer.

For the water, with the help of oceanographers from UCLA, the team created a 3D fluid dynamics engine that was built as a plug-in for Side Effects Software's Houdini. "There are lots of solutions for ocean waves," says Sjoholm, "but we were interested in sloshiness and how the water sticks to the bowl, not in cresting waves."

Refractions in his eyes and subsurface scattering on his skin helped enliven the fish and put him in the scene. With no lips or cheeks, his eyes carried all the emotion.

A raytracer in Wren rendered the water. "Usually when you see CG glass, it's easy, but our shots all had the camera smack up against the glass," Sjoholm explains. "It took a lot of bounces for the raytracers to capture everything the human eye wants to see in that environment. Sometimes we could fake it with mattes and 2D, but often we wanted caustics and pools of lights shining through the pebbles on the bottom."

To render a believable talking fish in a glass fishbowl filled nearly to the top with water (all CG), Rhythm & Hues used complex lighting techniques and many rendering layers, as these images illustrate.

And, then, fast as a fox,
The Cat in the Hat came back in with a box.

The lock on the box was a mechanical crab that sprang to life, jumped off the crate, and landed on the dog, thanks to the skills of André Bustanoby and Randall Rosa in the newly formed Stan Winston Digital studio. "The crab itself was a subdivision surface created in Softimage|XSI," says Bustanoby. Rendering was accomplished with Mental Images' mental ray and XSI. "We licensed a seat of HDR Shop (High Dynamic Range image processing and manipulation software) from Paul Debevec and used that to build maps for global illumination," he says. Once the lock was off the box, the lid opened, and purple goo began pouring out and overtaking the house.

"Now look what you did!" said the fish to the Cat.

The goo that oozed out of the box and the subsequent pinkish-purple tornado it became also were created at R&H. "We used blobbies with a voxel noise field in Houdini and [Side Effects'] vMantra," says Sjoholm. "It was a big violent thing that had to be nice and gentle for the kids, so rather than picking up the actors, we had it pick up objects that became warped as they were sucked into the vortex. For every scene there were several particle simulations going on at the same time—particles screaming out of the box, twirling around the actor, and picking up objects that were distorted by the animators. One shot had 83 layers."

To composite the shots, the team primarily used Apple Computer's Shake, with some work in Discreet's inferno and R&H's own Icy compositor. "We gave the compositors so many layers to have flexibility," says Jeff McLean, sequence supervisor. "The blobby stuff had to interact with the live-action plate, so we needed to tweak the colors of shadows, highlights, mid-tones, and so forth, and blend those things in compositing to get the desired look."

In addition to these 3D effects, R&H composited live-action and CG arms and other elements to build a cleaning machine, used Alias Systems' Maya Cloth to create a car cover, and substituted digital doubles for the children playing the Things when the script called for them to walk on the ceiling or flip in the air. The team also increased the film speed so that the children wouldn't move like real kids, created 3D matte paintings as set extensions inside the house and outside in the neighborhood, and even turned clouds into 2D line drawings at the end of the film.

Typically, though, the neighborhood skies were handled by Pacific Title. "They had to take plates shot in overcast and uneven lighting, pull the gray sky out, and add saturation and color," says Williams.

"I also used a small, four-person company called Cobalt to do simple compositing and fix-its in Shake, and CG work in Maya," Williams adds. "We distributed a great deal of effects work in the last few months and needed people to turn around shots quickly. I parked the lion's share of the 3D and CG work at Rhythm & Hues because we needed the big pipeline, and then gave concentrated bits of work to smaller facilities. Three years ago, I wouldn't have given 3D bits to the small shops, but I'm finding that because of products like Maya, boutique companies can push through 30 or 40 shots on a movie sometimes quicker than the large shops with big pipelines, especially if you aren't concerned about color."

Soho Effects, for example, quickly added CG hair to shots where the Cat, stuck to the ceiling, is scratching himself and his hair drifts down. They also somehow fit a bullring into a room of the house using Shake to assemble stock footage and replicate crowds.

In addition, a small studio called Hatch, working with the studio Imaginary Forces, created the opening sequence during which the camera moves through a line drawing of clouds that segues into 3D clouds revealing the town. "It takes us from the printed page to the real world," says Williams. "And then at the end, we segue back into the book."

It's as if inside the covers of the old, beloved book, a magical world was unleashed and then neatly put away an hour and a half or so later.

Said the Cat in the Hat, "I always pick up all my playthings..."
And he put them away. Then he said, "That is that."
And then he was gone with a tip of his hat.

Quotes excerpted from *The Cat in the Hat*, Dr. Seuss (pseud.), ©1957, 1985 Dr. Seuss Enterprises, L.P., Random House, NY.

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Barbara Robertson *is a contributing editor of* Computer Graphics World *and a freelance journalist specializing in computer graphics, visual effects, and animation. She can be reached at BarbaraRR@comcast.net.*

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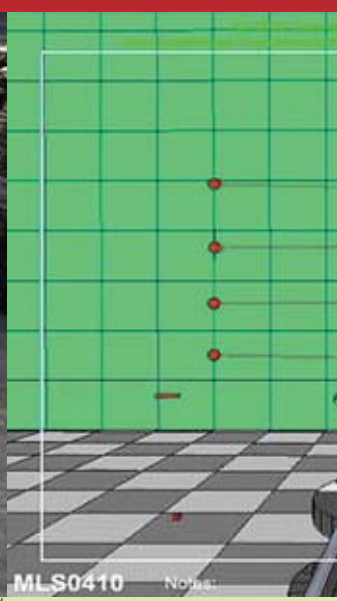
PART II: *Making the Matrix*

battle

The Matrix directors previz the high-rev action of Revolutions

By Karen Moltenbrey



Photos courtesy Warner Bros. ©2003 Warner Bros.-US-Canada-Bahamas-Bermuda; Village Roadshow Films (BZI), Ltd.

Last month, we presented an in-depth, behind-the-scenes look at the digital wizardry behind *The Matrix Revolutions*. This month, we examine the digital planning process for those effects.

A range of popular movie franchises has released sequels and prequels during the past few years. Yet none have been as ambitious as *The Matrix Reloaded* and *Revolutions*, which were created in parallel—in essence, as one huge movie—with only months separating their screen debuts. For *Reloaded*, digital artists focused on creating superhuman stunts, while for the more recent *Revolutions*, they created even "bigger" CG effects to portray the immense conflicts between man and the machines.

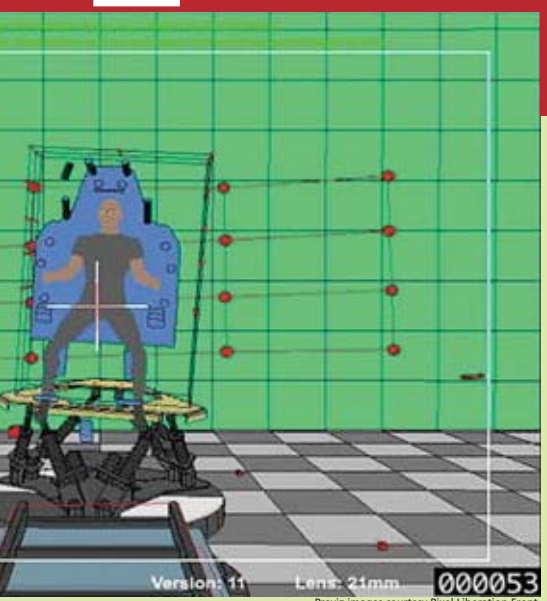
So how does a person plan and execute such groundbreaking shots? There's only one way, says visual effects supervisor John Gaeta, and that's by utilizing a wide range of previsualization techniques. "For films that are as technically complex as *The Matrix* sequels are, it was mandatory to develop a method of orienting all types of film craftspeople toward a common objective," he says. "As such, previz was used extensively to create a centerline of intent and objectives for the sequels."

Gaeta's previz group used these techniques extensively in many ways across many scenes in the films, from conceptual scene design to highly accurate stage planning and even more accurate camera-path planning, motion-base exporting, and rig-photography management. The visualization process—which began in mid-2000 and didn't end until mid-2002 when filming stopped—was the result of a long premeditated strategy by the directors, Andy and Larry Wachowski, and Gaeta, who introduced the brothers to the idea of using visualization to plan their complex Bullet Time shots for the first *Matrix* film.

"Those experiments weren't just for conceptualizing camera paths, but they also were used for every aspect of the [sequence's] setup and execution," Gaeta notes. "That experience empowered us to make two sequels that were extensively visualized."

For *Reloaded* and *Revolutions*, Gaeta and the Wachowskis previsualized as much of the effects content as they could and then provided that information to the vendor studios hired to work on the shots, all the while involving those facilities in the process as much as possible. "If you are going to get very literal with the viz, then the vendors need to be invested

plan



Previz images courtesy Pixel Liberation Front.

Previz was used to develop numerous scenes in *Revolutions*, yet the technique was never more imperative than when visualizing the action of the siege, including the motion of the humans and the APUs.

in the shots you have created to determine the downstream feasibility of the event you created in previz," explains Gaeta.

In many instances, the studios executed the visualization alongside the centralized previz group formed by Gaeta under EON Entertainment's banner. The backbone of this composite group was Pixel Liberation Front (PLF), helmed by Colin Green, PLF founder and previz supervisor for *Reloaded* and *Revolutions*. Assisting PLF and acting as Gaeta's logistics supervisors were visual effects supervisors John DesJardin and Dan Glass from EON.

The viz team's mandate was to work with the vendors as well as the departments within the principal photography group, including camera, lighting, and design, who would benefit greatly from the previz. "Our extensive use of previz required the support of the vendor visualization supervisors, who took the material and attempted to evolve it into a functional scene template," says Gaeta. "From that, they could retrofit next-generation components, whether it was viz-guided photography or computer-generated characters."

In fact, utilizing previz "for just about everything" was a novel concept for the *Matrix* producers, who had to be sold on the idea. "This is the largest visualization project in movie history," notes Gaeta. "Building a CG department within the production group was a different method for organizing crews and broke the tradition of limited use for limited purposes."

Previz at Work

In all, Gaeta estimates the group created more than two hours of previz content—basically an animated movie. Although not every scene in both films was previsualized, the majority of them were, falling into two main categories—photography management and CG development.

The 270-day film shoot involved countless scenes and shots with extensive greenscreen and bluescreen setups, CGI set extensions, and integrated CG characters. Having previsualized these shots, Gaeta could determine, for instance, where the action was taking place, what objects would be digitally created, and what types of camera perspectives were needed. Looser, or more basic, previz versions provided a general idea of where to point cameras, while more precise renditions allowed for the exportation of camera paths into robotic camera systems for scenes whose filming required the use of a motion-control base.

On the flip side, the previz was used for shots that were 100 percent computer-generated. For these, the scenes were logistically immense and extremely costly. Yet by creating entire scenes and editorializing the previz shots, Gaeta and the directors were able to determine, for instance, how many objects were needed in each frame for budgetary purposes. It also enabled vendors to calculate their own costs, and it eliminated a lot of unnecessary work.

In a more complex application, Gaeta used previz to find unique camera and lens styles for capturing thrilling shots, including Bullet Time shots, those involving vertigo-like lens effects that don't necessarily follow straight paths, and complicated curving camera moves with floating interest points. "We did a number of virtual photography and Bullet Time shots that would have been impossible to do to their full potential without visualizing them ahead of time in 3D," he points out.

In fact, one of the most elaborate shots in *Revolutions* didn't make it out of the previz stage. This scene had Neo flying through the mega city in a curved, zigzag pattern while the camera orbited his body and sliding lenses created a feeling of vertigo. The shot was nixed because of its steep $1 million production price tag. "It was super killer and my favorite," says Gaeta.

Aside from that scene, the group spent a year conceptualizing and designing the visual effects for the freeway chase in *Reloaded*. That work, in turn, lead to the Trinity Falls and Trinity Saves scenes, and

the siege on Zion in *Revolutions*. As the filming began, the visualization became the backbone of the stage planning and technical orientation for a variety of the film departments at EON, as well as vendor templates from which they could build scenes and shots.

"We used previz for all the flying design—which was a high-concept study area—including the scene when Neo flies out of the flaming building and down the street at 2000 miles per hour," notes Gaeta. The tool also was used to plan the unique camera perspectives in the super brawl between Agent Smith and Neo, and for constructing the digital face and determining the camera proximity for the ultra-realistic Smith model used for the super punch (see "The Matrix Resolution," December 2003, pg. 22).

The directors used previz (top) to define sentinel behaviors for the final shots (bottom), such as how fast the sentinels would move and how big the swarms should be.

"People may be curious as to why certain shots have a unique layout or wonder how a person arrives at a certain perspective," Gaeta says. "Well, the idea is an amalgamation of the creative minds of the director and concept artists, and a by-product of the creative 3D exploration process."

Besieged with Ideas

Revolutions, in fact, includes some of the most highly choreographed combat scenes to play out on the big screen, including the siege, a 12-minute sequence depicting the battle between the humans and the squid-like sentinels. With 90 percent of the scene created digitally, it's the largest CG segment in the movie and a climax in the *Matrix* saga. "A scene like that costs tens of millions of dollars," says Gaeta, "so you can't afford to make any mistakes while shooting the live-action pieces."

Executing this detailed, extremely complex showdown at Zion turned out to be a monumental battle in itself, as the previz group spent more than a year planning just that one sequence. In the end, their effort provided the effects team at ESC Entertainment with a tangible blueprint to use while realizing the directors' elaborate vision on film.

While the finished sequence is impressive, DesJardin notes that the conceptualized scene was far grander in scale. However, during the previz process, it became apparent that the brothers had to pare it down to clarify the action and story points for audiences and to enable ESC—which was being formed as a studio at the time of the previz—to finish the sequence on time. As a result, the effects supervisors and, in turn, PLF spent a tremendous amount of time reacting to the changes.

The directors wanted the siege to be emotive as well as illustrate the dynamic struggle between the humans and the machines. And conceptualizing a battle sequence between the armored defenses of an underground city and hundreds of thousands of flying sentinel robots is really beyond the imagination of anyone but the directors, contends DesJardin. Thus, it had to be defined visually as a sequence in order to be fully and accurately understood by the hundreds of artists creating it.

Moreover, the sequence had to address numerous plot points—for instance, what kind of battle tactics do the humans and machines employ, how do the humans initially fend off the machines, and how do the machines eventually outsmart and conquer the humans—all of which dictated how the battle had to evolve. "They had to show a reason why the sentinels are attacking in schools and groups," says Green. "They also had to show the cause and effect of the background animation, such as what happens to all the dead sentinels—an issue worked into the story line when the humans have difficulty reloading the APUs because the debris is piling up on the catwalks. All of this had to fit within a coherent battle plan."

Even the directors evolved their vision for the siege, as well as many other scenes, as the previz group planned the scenes visually. Working from storyboards and concept drawings, the team created an extensive animation of the siege using low-resolution models of all the objects in the scene, which were created in Alias Systems' Maya. Breaking the shot-by-shot paradigm of traditional animation, the previz animations were created in 15-second chunks that recorded an event from a number of camera angles.

While nearly all of the previsualization for *Reloaded* and *Revolutions* was done in Softimage|XSI running on Hewlett-Packard machines and specially built PCs, PLF chose Maya for the siege work. Creating the lower-resolution images in the same software package that ESC planned to use for constructing the final complex imagery in the CG-heavy sequence enabled ESC to work directly from the previz components.

While planning the siege, the team also used previz onset to generate the hybrid human/robotic motion of the Armored Personnel Units (APUs), massive machines that mimic the movements of their human operators. In essence, the robot is an exten-

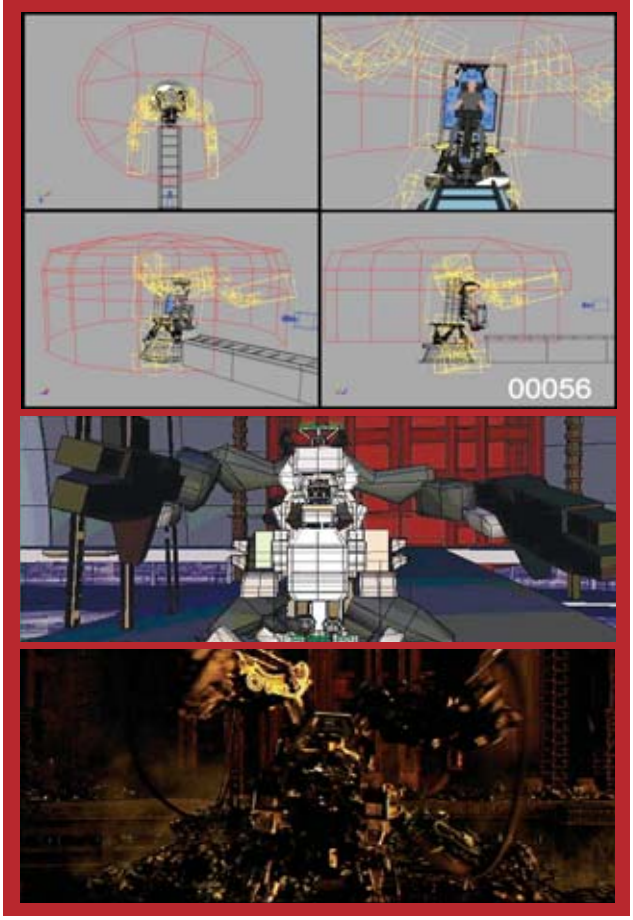
Previz imagery (such as at left) was used to plan many final film scenes (such as shot at right).

sion of the human piloting it, so as the person lifts an arm and presses a trigger, for example, the APU's huge robotic arm lifts and fires a weapon. Having a visual connection between the robot and the powerful forces it was applying to the pilot was vital to selling this concept.

For this segment, Gaeta wanted shots that started wide, where you see the APU doing its various moves, and then push in close to show that a real human is driving the robot. This was done by importing the CG motion to a motion-control simulator, thereby synchronizing the CG and the live action and mimicking motion that under any other condition would have been impossible to replicate.

To accomplish this, PLF acquired the fully fleshed-out APU animation files from ESC, which created the robotic models and their walk libraries. Under Gaeta's direction, Green then devised a setup that would take the APU animation and the camera animation from ESC and turn it into motion-controlled camera-move files and motion-base files.

To forge an intimate relationship between the APUs and their human drivers, PLF set up a complex pipeline that converted the APU animations into motion-controlled camera and motion-base files (top) for matching the live action to the CG (middle) for the final shot (bottom).



According to DesJardin, this sequence was the most difficult to previz because of the importation and exportation of position data to achieve the precise moves that Gaeta and the directors wanted. "We were photographing a live element (the actor) that had to be accurate to the animation in order to achieve all the bumps, sways, and inertia on the human," DesJardin says, "so when the CG character was added, it all made sense and the animation lined up perfectly."

Despite using state-of-the-art camera equipment and a high-end motion base, the original motion still had to be smoothed and scaled, and the camera and APU motion had to be translated from Maya (which ESC used) into Softimage|XSI, where a virtual Milo motion-control camera and virtual motion base were constructed.

A Vital Virtual Process

"Highly conceptual and highly accurate camera-path planning and perspective control via motion-base exports can be refined to an exact science," Gaeta says. "It's when to use it and apply it accurately that ultimately matters." While previz has assumed an increasingly important role in film production, Gaeta believes that supervisors from both the facilities and the production visualization department must forge a closer relationship before new ideas in photography will be unlocked.

While studios and directors implement previsualization for different reasons, some—like the Wachowskis—see it as a way to make a better movie. "Many people use it as a thought process to arrive at their visual objective," says Gaeta. "For me, it unlocks my imagination. I see far beyond the simplistic cartoons that are the result of some of our visualization sessions. It's my job to evolve these impressionistic blocking animations into something that has all the matter of nuance and action. I see it as completely vital to getting great shots."

According to Gaeta, if you want to acquire the type of film shots that seem impossible to accomplish, then you need to create and apply an entire palette of previz applications, including design and directorial, originating visual effects concept, sophisticated and general stage planning, and highly accurate camera-control and motion-base exports.

"Bullet Time, as we've approached it in the first *Matrix*, was basically undoable without visualized strategies," Gaeta notes. "In these sequels, we've turned the previz process into an entirely centralized production nerve center accessible to all facets, from the physical to the digital departments.

"Would I consider making a film like this without using visualization? Absolutely not," Gaeta adds.

Karen Moltenbrey is a senior technical editor for Computer Graphics World.

CSI: DALLAS

In this crime scene investigation of the Kennedy assassination, a computer simulation dispels the persistent conspiracy theory

By Karen Moltenbrey

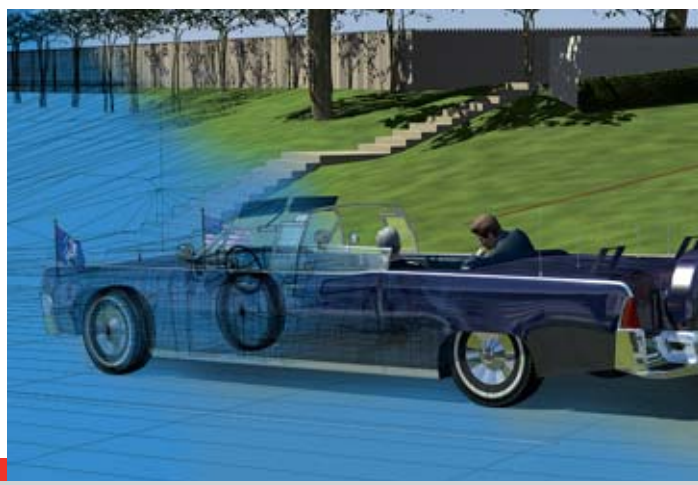
Who shot President John F. Kennedy? Four decades after the tragedy in Dallas, it's still one of the most enduring questions of our time. Despite the findings of two major governmental investigations, many Americans today still doubt that Lee Harvey Oswald acted alone, if at all. A key piece of evidence that is used to support both sides of the controversy is an 8mm home movie of the shooting captured by local resident Abraham Zapruder.

Forty years later, freelance computer animator Dale Myers definitively answered the lingering question during an ABC special marking the anniversary of the assassination. Using state-of-the-art film and computer graphics tools and techniques, Myers explained how he built an exact 3D re-creation of the scene as captured by Zapruder that precisely matches that archived film frame for frame. Then, tracing the fatal bullet's trajectory within this three-dimensional space, he showed that the shot aligns to the 6th-floor window of the Texas School Book Depository—the exact location from which Oswald was determined to have been—and not to the grassy knoll where some speculate that a second gunman had been.

"It only happened one way and because of all the photographs that exist, we were able to visually re-create that one way based on fact from the filmed record," Myers says.

CG Investigation

Long ago, Myers also believed in the popular theory that Oswald was framed or had an accomplice—and that a number of people were involved in the subsequent cover-up. In the mid-1970s, he viewed a poor-quality bootleg copy of the Zapruder film, which had not yet been seen by the general public, and began his own investigation when the film showed Kennedy's head lurching backward after he was struck, indicating the bullet had entered from the front, not from the direction of the depository.



Animator Dale Myers re-created Abraham Zapruder's film of the Kennedy shooting frame by frame inside LightWave, which resulted in an accurate three-dimensional view of the scene.

After seeing this, Myers began thoroughly researching the assassination. And 10 years ago, he decided to meld his personal interest in the case with his skills as a freelance animator by re-creating the event in 3D by using the first version of NewTek's LightWave 3D. The models were simplistic, but they were accurately built and animated. And they showed that the conspiracy theory was wrong and that Oswald had fired the fatal shot.

"Any 2D photograph contains the necessary 3D geometry, or the spatial relationships of the objects in its field of view," Myers explains. "Therefore, I knew I would be able to build a three-dimensional model of Dealey Plaza, the car, and the occupants. And because we know where Zapruder was standing, I could create a virtual camera and align his film with the three-dimensional model, in essence, putting his film back into its original 3D form."

As the anniversary of the assassination approached, a friend working with ABC suggested that Myers' work could offer a fresh view for the network's planned broadcast. Meanwhile, Myers had been contemplating a digital face-lift for the entire animation, which he still plans to complete. Until then, he licensed six and a half minutes of revamped CG to ABC, including the crucial moments when President Kennedy and fellow passenger Texas Governor John Connally were shot.

Building the Scene

Initially, Myers thought that he could just swap out the generic humanoid characters for realistic models and replace the hybrid car (which contained accurate dimensions) with a detailed model of a 1961 Lincoln. "But I soon realized that the modeling and animation methods had evolved greatly," he says, "requiring me to redo the entire sequence from the ground up."

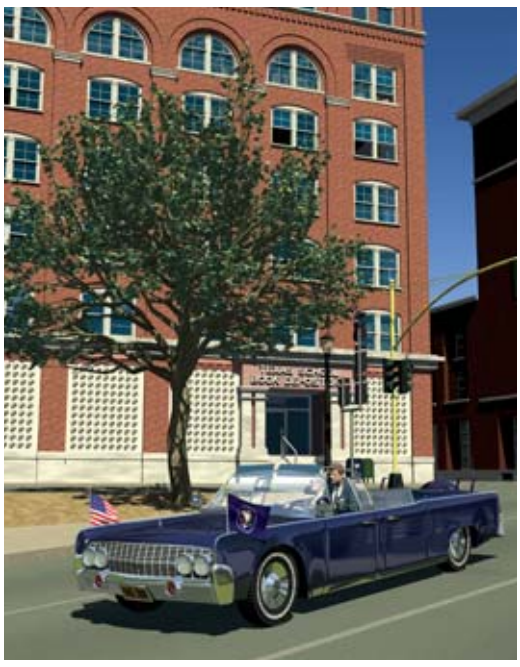
First, Myers collected a series of photographs and hired a sculptor to craft life-size busts of Kennedy and Connally, from which he made plaster castings. Using Immersion's MicroScribe 3D digitizing arm, which captured the dimensions of the busts, Myers created a highly detailed virtual replica of each. "However, ABC and I both agreed to pull back on the realism by eliminating the fibrous hair, the facial details, and the super-real skin shaders so the models appeared mannequin-like, eliminating the shock factor and providing a scientific appearance to the animation," he says.

To create the bodies and the clothing, Myers adapted Viewpoint models (now offered through Digimation), and added expressions, or mathematical equations, in LightWave 7.5 for accurate cloth simulation—which is vital in determining a bullet's trajectory in the frame where Connally is shot. Myers built the car from NURBS in LightWave, using body-draft information published in the two governmental reports. And to re-create the area, he and his technical assistant, Jon Tindall, used more than 500 of their own plaza photos and a great deal of other information about the event and the location, including survey maps and actual blueprints of the book depository.

From the photos, Tindall generated environmental texture maps within Adobe Systems' Photoshop. One of the biggest challenges was re-creating the foliage, which included 16 trees and numerous bushes. To accomplish this, the animators purchased a detailed (40MB) oak tree model. But because of its size, Tindall initially could load only five tree models, despite using a 3DBoxx workstation from Boxx Technologies with 4GB of RAM, dual Intel Xeon 3.06 processors, and a 3Dlabs Wildcat4 7210 graphics board.

"Foliage makes great-looking CG," claims Myers. "But it's memory-intensive. So if you have an extensive scene in terms of object size, you usually pull back on the foliage. Yet I wanted this outdoor scene to look terrific, which required Tindall to find a way to add all 16 trees and make each look as good as the 40MB model."

Tindall's solution was to cull the model by eliminating polygonally described branches inside the thick canopy and changing the transparency maps of the leaves to a clip map, which is more efficient to render. As a result, he was able to reduce each tree to 500KB without suffering a perceivable loss in quality, buying additional memory for adding detail to the buildings and other objects in the scenes.

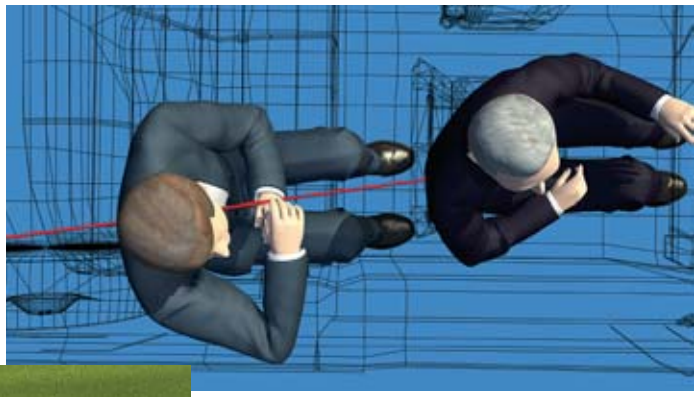


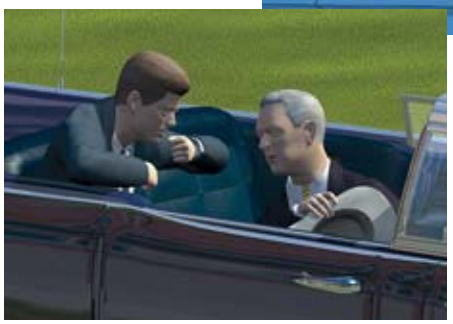
Using many references, including personal photos, the animators re-created Dealey Plaza (top), including the foliage. This CG still (bottom) shows the president's car passing through the plaza just moments before the shooting.

After building the models and the background, Myers worked frame by frame inside LightWave, superimposing the models onto their counterparts from the Zapruder film to achieve a virtual replica of the scene, complete with a virtual camera synchronized to the actual camera. To do this, he aligned and matched the speed of the Zapruder camera pan, resulting in a digital handheld view of the empty road. He then added a second layer that places the moving car into the scene, again matching the precise motion from the film.

Finally, Myers integrated the vehicle's occupants, choosing to add only Kennedy and Connally for visual clarity and to streamline the modeling/animation process. To determine the precise positions of the two men in the car, he enlarged the portion of the film showing both in center frame during the shooting.

"Once we did all that, we had a frame-for-frame digital match of the Zapruder film," says Myers. "But what many people don't realize is that when you bring a copy of the film into the computer, you have to convert it from one format to another, from a video rectangular-pixel world to a CG square-pixel world or vice versa. That's why people who are unfamiliar with the mediums have difficulty replicating the results on their own."





President Kennedy and Governor Connally were positioned inside the vehicle (left) as they were in the Zapruder film. Using a wireframe view (above), the animator traced the bullet's trajectory back to Oswald's position in the book depository window.

As Myers explains, Zapruder's silent 8mm color record—the only known film of the entire assassination—was available in a digital video format. When that was imported into the computer, the aspect ratio difference between the digital video and the actual film posed problems in aligning the film with the computer models. So Myers converted the digital video back into its original film aspect ratio using specifications that were standard for 8mm film from the period to achieve an exact conversion.

After the alignment was completed, the animation, which was keyframed to match Zapruder's original 18.3 frames per second (fps) film, was "rephotographed" at 30 fps in a digital video format. Although Myers used a partly rendered/partly wireframe CG animation of the event running at Zapruder's original frame rate of 18.3 fps to show the events just prior to the shooting, when the car emerges from behind a sign blocking the view—at the moment Kennedy and Connally are hit—the models turn into solids. At this point, Myers rendered the animation at today's 30 fps standard, and all the key positions were automatically adjusted inside LightWave. As a result of this process, the imagery was much smoother and clearer than it was in the Zapruder version, revealing details that were present all along but were difficult to see.

Digital Results

During the broadcast, Myers pointed to the Zapruder film showing the limousine as it just completed its turn onto Elm Street. Frame 133, he notes, is the first in which the president can be seen, and Frame 160 is when the first shot occurs. Apparently that bullet missed the intended target, as the governor is shown turning sharply to his right in the direction of what he later said sounded like a high-powered rifle discharge. A few frames later, the car disappears, and then in Frame 223, it emerges from behind a freeway sign with Connally coming into view first, seemingly uninjured.

"You can see his white shirt, jacket, and a gray area where the tie is," Myers pointed out. "Then something happens between Frame 223 and 224. The jacket changes shape; it pops out, or folds out, a little bit. In fact, the bullet has just struck him in the right side of his back and emerged from [his chest]. In the next frame, the president comes out from behind the sign, and we can see a kind of anguished look on his face. His hands immediately go up toward his throat in a guarded manner. Both men are acting simultaneously."

So, if both were hit from behind with the same bullet, where did it come from? Using the men's body positions and locations of their wounds, Myers isolated the source of the shot by connecting Connally's entrance wound to the exit point from the president's throat, then projected that line rearward to its source—the sniper's nest in the depository.

In contrast to when Myers first re-created the event, this time he already knew the results that would answer one of the biggest mysteries of the 20th century. "Because I had better-quality imagery from which to work, some of the numbers [calculations and measurements] were slightly different," he says. "But like any valid scientific experiment, I was able to repeat the process and come to the same conclusion. And the animation shows that there wasn't a magic bullet at all," he says, referring to the belief that an inconceivable ricochet was necessary in order for both men to be struck in succession.

"It's not even a single-bullet theory in my opinion," Myers adds. "It's a single-bullet fact proven by the animation."

Karen Moltenbrey is a senior technical editor at Computer Graphics World.

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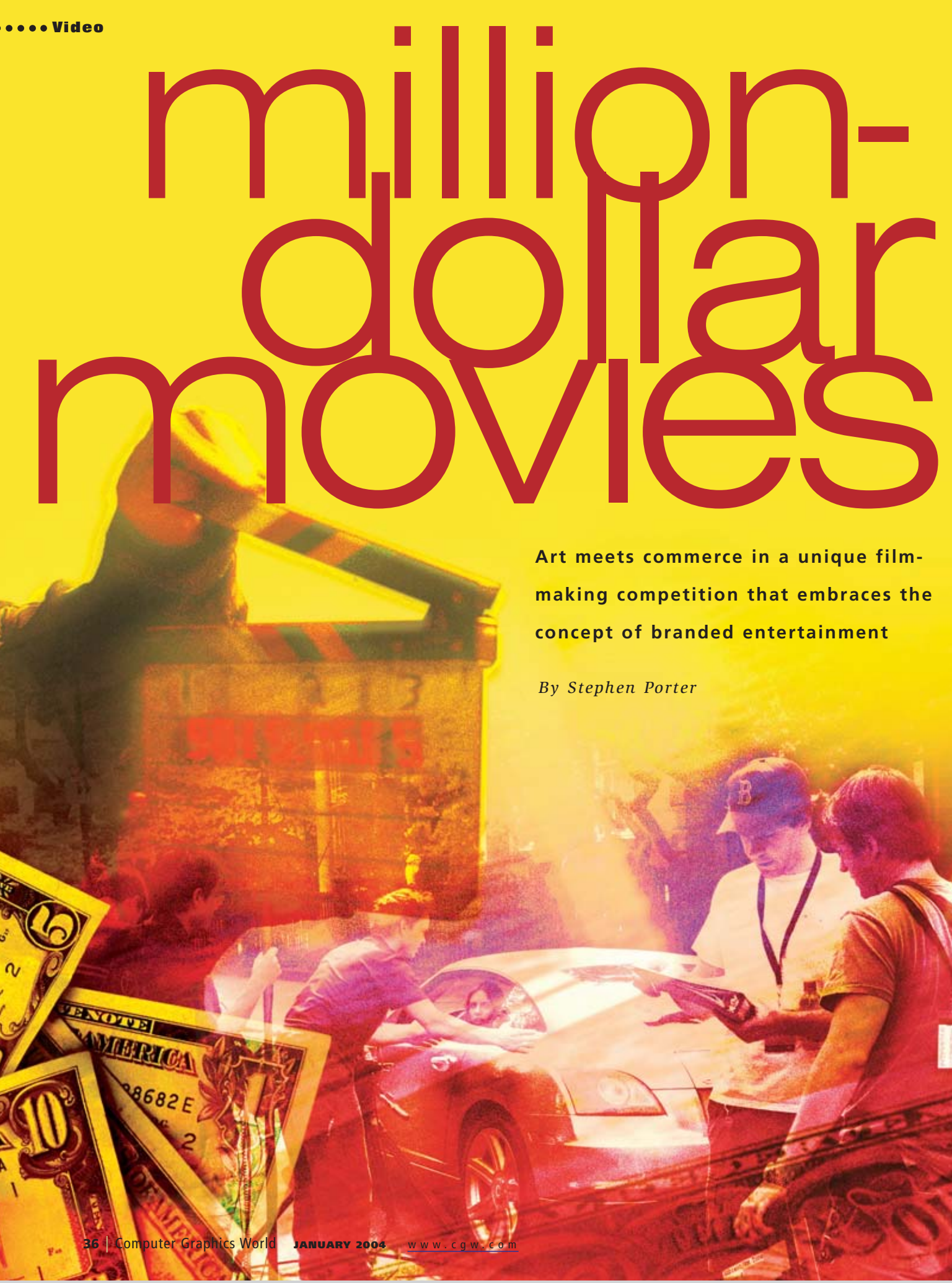
million-dollar movies

Art meets commerce in a unique film-making competition that embraces the concept of branded entertainment

By Stephen Porter



t was a huge year for Andrew Mudge. Twelve months ago, Mudge was one of the hundreds of short filmmakers who pursue their moviemaking passion in relative obscurity. Although his short films have won their share of awards over the years from various film festivals, the goal of reaching the big time remained a distant dream.

That all changed in September, however, when Mudge was named the winner of the 2003 Chrysler Million Dollar Film Festival (CMDFF). In addition to providing him with a one-million-dollar feature-film production and distribution deal with Universal Studios, the win raised him out of the pack of moviemaker wanna-bes and transformed him into one of the movie industry's new faces to watch.

Whether Mudge will parlay this golden opportunity into big-screen success remains to be seen. But at the very least, he says, "winning this gives me better credibility and an established name in a world where it's next to impossible to get a name."

Although the Chrysler Million Dollar Film Festival doesn't yet enjoy the same kind of name recognition among lay people as the Sundance Film Festival or the Cannes Film Festival, the three-year-old event has attracted the attention of industry insiders thanks to its million-dollar payday, its unique format, and the lavish promotional events hosted by Chrysler.

In truth, the name is a bit of misnomer, as the CMDFF is not so much a festival as it is a nine-month long, multi-phase competition. It all began with the submission of nearly 700 short films to a panel of judges. From that group, 25 quarterfinalists were selected and flown to Park City, Utah, in January for the kick-off event of the festival—a screening of all the films. There, another panel of judges selected 10 semifinalists to enter the Extreme Filmmaking phase of the competition, where the fun really began.

During this phase, the 10 semifinalists were required to cast, shoot, edit, and premiere a 5- to 10-minute short film in New York City in just 10 days, using a Panasonic AG-DVX100 24p digital camera and an Avid Xpress DV editing system. (All 10 of those short films can still be viewed online at www.chryslermdff.com.)

That group was then whittled down to just five finalists for the final round of the competition. For this, the competitors spent two months during the summer at Universal Studios in Los Angeles developing a feature-film project. They even got to shoot one scene from their proposed movies using Panavision HD video cameras, Avid Media Composer Adrenaline editing systems, and Avid DS HD finishing systems.

Dual Goals

Clearly, one of the main objectives of the competition was to uncover the next generation of talented young directors and give them a chance to demonstrate their skills while providing them with an education about the filmmaking process. "I think the filmmakers learned a lot," says Nicolas Karlson, senior director of production at Hypnotic, a New York City- and Los Angeles-based entertainment production and distribution company that was the original creator of the competition. "We definitely put up some flaming jagged hoops for them to jump through. We asked them to shoot a project with limited resources and limited time. And then we asked them to develop a feature film in just a few months."

But while discovering and developing new talent is the competition's primary purpose, its other goal is to serve as a vehicle for promoting the Chrysler brand and the somewhat controversial concept of branded entertainment. It's a field in which Hypnotic plays a pioneering role, in addition to the more traditional work it does in producing and distributing short films, feature films, and television shows.

According to Karlson, Hypnotic first started the festival three years ago as a way to become familiar with more filmmakers. "There are thousands of small production companies out there making independent feature films," says Karlson, "and we thought the competition would be a good way to get a little publicity, so we could see more scripts, more filmmakers, and more short films."

After the first year, however, the company decided to expand the event and bring in a sponsor interested in entering the branded entertainment space. That's when Chrysler entered the picture.

Chrysler was a perfect sponsor for the competition, says Karlson, because they were looking to produce and distribute branded entertainment that resonated with a younger demographic. In addition, he says, "They saw this as an opportunity to establish a presence in the film entertainment community."

With Chrysler onboard as a sponsor, Hypnotic incorporated the concept of branded entertainment into the CMDFF in the Extreme Filmmaking stage of the competition. During this phase, the short film had to incorporate as an integral part of the story line either one of two specified models of Chrysler cars: the Chrysler Crossfire sports coupe or the Chrysler Pacifica SUV.

Jonathan Farrell, senior director of marketing for Hypnotic, explains that branded entertainment is different from product placement. Product placement simply involves inserting a company's product into a scene of a movie or TV show, whereas branded entertainment entails integrating a company's product

Filmmaker Andrew Mudge offers some direction to the actress behind the wheel of the Chrysler Crossfire during the filming of his short film, *Gabriel Y Gato*.

or service into a production from the beginning in a way that's strategically important to the story line, without having the production viewed as blatant product promotion.

The key to making it work, Farrell emphasizes, is to produce something that works first and foremost as entertainment. It shouldn't come across to the viewer as a commercial. At the same time, however, it needs to provide a positive boost to the sponsoring company's brand.

The concept of branded entertainment as a business is still evolving, Karlson concedes, making it a little difficult to precisely define what branded entertainment is or is not. And it can be a concept that can generate a fair amount of controversy, particularly among young directors who feel it blurs the line between art and business.

Competing Priorities

"It's difficult," admits Karlson. "There have been lots of arguments. It's been one of my responsibilities to talk out of one side of my mouth to the filmmakers and out of the other side to the branding company and the ad agencies to try and get them to come to a common ground. We've never had a filmmaker say, 'No I won't do it.' But we've gotten close," he says.

For his part, Mudge admits he has mixed feelings about branded entertainment, and acknowledges that at the very least it can put restrictions on what kind of story a filmmaker can tell. For example, he says, "When they gave us the rules, they didn't want to have drug dealers driving these cars."

Despite that, Mudge felt good about the short film he made. "I had no feelings of selling out," he says, "because I truly liked the story and would have done it anyway, almost."

In his short film, entitled *Gabriel Y Gato*, Mudge tells the story of a boy who loses his favorite remote-control car. Then, 10 years later, as he's packing up his belongings following an emotional breakup with his girlfriend, he comes across the old remote control for the car. When he turns it on, the car magically comes back to him. But this time, like the character himself, the car has grown up, and it has become the Chrysler Crossfire. "The car fit perfectly into the story," says Mudge. "It was the hero at the end of the movie. It's was kind of inspiring."

As difficult as it can be for young filmmakers to get comfortable with the concept of branded entertainment, it can sometimes be just as difficult a concept for the business folks who are eager to see their brand get promoted. For example, says Karlson, "When you have a company like Chrysler that is supporting a large program, it's tough when you have to say to them, 'We are not going to show this car a lot in this film because it is not in keeping with the tone of the story. But don't worry, it's really well branded, and when the car is there, it really pops because it is a pinnacle of the story.'

"So you have to try and explain how a three-act structure works and how, although their product is on-screen for a brief period, that's the moment that everything's been leading up to. So the impact is big," says Karlson.

Philosophical wranglings aside, Mudge says the Extreme Filmmaking segment of the competition was enormous fun, if a bit insane. "Given 10 days and a five-person limit on the size of the crew, we cast, shot, and edited the film," he recalls. "They gave us a hotel suite with Avids and Avid technicians. I had an editor who just edited, and after I'd shoot, I'd come back and edit with her. It was a run-and-gun kind of shoot," Mudge adds. "Fortunately almost my entire movie took place outside, so we

The Technology

When it comes to the different types of media one can use to shoot a movie, Andrew Mudge leaves no doubt as to what his preference is. He's a film guy.

"I consider myself a filmmaker, and I hope to always make movies on film," he says. "It all comes down to the movie theater—what we see when the lights go down. I love film because of the way it looks when it's done."

Paul Cotter (right), one of the film festival finalists, and his editor, Bob Ackerman, work on the Avid Media Composer Adrenaline system during the Final Round of the competition.

Despite that bias, he acknowledges that digital video has its advantages, especially in terms of ease of use and cost during production and postproduction phases of moviemaking. During his participation in the Chrysler Million Dollar Film Festival, Mudge got to explore these advantages in detail, given that the festival's organizer, Hypnotic, made digital video the medium of choice.

In the Extreme Filmmaking phase of the competition, Mudge and his fellow competitors shot footage with Panasonic AG-DVX100 24p camcorders and edited on Avid Xpress DV workstations. In the Final Round feature-filmmaking phase of the competition, the filmmakers shot scenes with a Panavision HD camera and employed an all-HD work flow that included an Avid Media Composer Adrenaline and an Avid DS HD workstation.

According to Nicolas Karlson, senior director of production at Hypnotic, the decision to use digital video technology was based in part on the feeling that exposing the participants to new types of digital production and postproduction processes was in keeping with the overall cutting-edge flavor of the competition.

Beyond that, says Karlson, was the sim-

just hustled through, racing around the city in cabs and getting shots. The DV format made that very easy."

At the end of the contest, the 10 short films premiered at the Directors Guild of America's theater, where a panel of judges picked the five finalists, who were then invited to spend two months at Universal Studios in Los Angeles developing a feature-film project.

The final round of the competition was a completely different experience from the Extreme Filmmaking stage, says Mudge. There, he got to work with professionals from Universal and Working Title Films to develop a script and storyboards for a feature-length movie. The movie idea was one that had been in the back of Mudge's mind for some time. Entitled *The P.T. Johansen Field Guide to North American Monsters*, the movie is a dramatic comedy about a young boy who gets caught up in a Bigfoot hoax.

Working with HD

Mudge also got the chance to shoot one scene from his movie on a stage on a backlot at Universal. And in contrast to the Extreme Filmmaking phase, Mudge got to work with high-end HD equipment and a crew of 45 people. In fact, he decided to make as much of this unique opportunity as he could.

"I thought, 'Hey, I'm at Universal, I'm going to have fun,'" Mudge says chuckling. "So I used rain machines, and I had lightning and a lot of tricky lighting. If I was going to have access to all the amenities at Universal, why not do all that stuff?"

Once the summer was over, the five finalists took their feature-film projects and pitched them to yet another panel of judges at an event in Toronto, where Mudge emerged as the winner.

Looking back, Mudge describes the whole experience as an extraordinary learning experience and a tremendous opportunity. "This was the first time I've ever been able to make anything that was produced by someone else, which was really special. I got to make a short film—the Chrysler one—that someone else paid for. They did all the worrying that I usually do. "

A scene from Mudge's full-length feature, *The P.T. Johansen Field Guide to North American Monsters*, appears above.

Of course, the biggest opportunity of all is the chance Mudge now has to establish himself as a true Hollywood director. Plus, he's already been hired to shoot a TV commercial, which is something he's never done before, so the benefits of winning the competition already are rolling in.

According to Hypnotics' Karlson, those kind of benefits are exactly the type of things the CMDFF are meant to encourage, even for those who didn't win the competition. "Most of the finalists from each year have been signed by managers, agents, or have had TV deals or film deals set up. So in terms of success, they suddenly have a platform on which they can perform. It's a mix of incremental smaller successes. But from where they were before the competition, it's a tremendous leap. It's a way to rise above the crowd."

***Stephen Porter** is a contributing editor of* Computer Graphics World *and a freelance writer who covers video, graphics, and digital content creation. He can be reached at sporter@gsinet.net.*

ple fact that the competition needed the speed advantages that digital video brought to the production process. "We were going to be moving too fast to work with film," he says. "Plus, we wanted to use a production process that was more individual and would put more weight and responsibility on the directors' shoulders to see what they were made of."

As part of its support for the competition, Avid provided both equipment and 24/7 on-site tech support to the participants. And during the Final Round of the postproduction process, Avid specialists manned the DS HD finishing systems.

From his perspective, Mudge acknowledges he was impressed with the tools. Shooting with the Panasonic camcorder during the Extreme Filmmaking phase of the competition give him freedom to move quickly and shoot on a tight schedule, while the Avid Xpress DV software provided a smooth editing interface.

Regarding the feature-filmmaking phase of the competition, Mudge says he appreciated the Adrenaline's speed and its ability to show high-resolution images during the editing process. "If you can see things in hi res when you are storytelling, it makes editing easier," he says. "You can feel the story better. You can get into it more."

Still, the experience didn't sway Mudge from his preference for film. But he agrees that using video technology for the competition made sense. "Video is good for any kind of storytelling where you just want to let the camera run," he says. "It brings an element of spontaneity to the production that you can use to your advantage. With film, you can't do that."

"On the other hand," Mudge adds, "when every detail and every shot is planned, film is better. And it gives you a cinematic look. Ultimately, it doesn't really matter what you go through when you are on set. It's about what it looks like in the theater."

Avid doesn't argue, because from its perspective there's a role for a digital production process even in a world of film. "Avid doesn't really care what the acquisition format is," says Charlie Russell, Avid senior product manager. "It's about tracking all the elements—keycode, camera roll, video timecode, pull-down relationships—regardless of what you shoot on. The same work flow and processes need to be in place. More and more people in the film industry are starting to use HD dailies, even if they are shooting on film." —*SP*

Art Studio

Jen Zen

Clockwise from top left:
Centaur The first 3D freehand drawing Grey created in Surface Drawing was this centaur (half man/half horse) that looked like a metallic cyborg with a tail made from "liquid fire." The resulting work, called "Centaur," is now on tour with the ACM SIGGRAPH 2003 Traveling Show, following its public debut in the conference's Art Gallery this past summer. A number of images from that series appears here, along with an image from her new "Fire and Ice" series inspired by her memories of the Alaskan ice fields.

Leap (dual image is from the "Centaur" series)

Badwater (from the "Centaur" series)

When computer processing speeds improved to the point that artist Jen Grey could paint as fast with a mouse as she could with a brush, she quit mural painting and assumed the persona of her alter ego, Jen Zen, a cyber hyperrealist. "Why climb scaffolds when virtual space can be so much bigger?" she asks.

A professor of art at California State University Long Beach, Grey now creates unusual pieces of art by experimenting with atypical digital tools. A few years ago, she and fellow artist/collaborator Sheriann Ki Sun Burnham began beta-testing various offerings, including Steven Schkolne's Surface Drawing software, which enables artists to create 3D shapes through hand motions. As the hand moves through space, the trail of its motion is recorded by the computer as a stroke, which appears to float in mid-air, thanks to a head-tracked stereoscopic dis-

play environment. Using this program, Grey (Zen) and Burnham began creating models they termed "zenki" figures, a name derived from parts of their individual monikers.

The artists created figures by patting, or tracing, a live human model using an Immersion CyberGlove linked to the software running on a Caltech Workbench, a proprietary semi-immersive drawing environment. According to Grey, her cyborgs exist as life-sized 3D "motion-captured" figures in virtual reality. She exports the images as SGI Inventor files to Corel's Bryce for editing, texturing, and lighting. Then, she "flattens" the images and composites them into a digital scene crafted in Adobe Systems' Photoshop or Corel/Procreate's Painter.

A selection of Grey's images appears on these pages. Additional pieces can be viewed at her faculty Web site (www.art.csulb.edu/academics/faculty/index.html). *—Karen Moltenbrey*

Clockwise from top left:
Dante's View (from the "Centaur" series)

Fire and Ice (from the "Fire and Ice" series)

Weed (from the "Centaur" series)

Final Spin (from the "Centaur" series)

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Avid Media Composer Adrenaline

Adrenaline receives a hefty upgrade

By Jeff Sauer

Avid Media Composer Adrenaline provides users the ability to preview multiple layers simultaneously.

With Media Composer Adrenaline, Avid, for the first time, exploits today's multi-gigahertz CPUs rather than relying on dedicated hardware cards. At the same time, Avid has dropped prices considerably. Its Media Composer Adrenaline replaces the full line of on-line and off-line Media Composers priced two to three times higher (although Avid will still support and develop for Meridien systems). But, the only hardware Media Composer requires now, aside from a qualified workstation, is the Adrenaline accelerator.

Because the Meridien hardware enabled Media Composer to edit two streams of full-frame uncompressed video in real time, losing it may seem frightening. Leveraging the work Intel has been doing to increase processor speeds, Avid's release amazingly plays five simultaneous streams of uncompressed video in the timeline on a 2.8GHZ workstation using only the CPU and Adrenaline. Avid's benchmark of five layers of uncompressed video is admittedly an approximation; the number of simultaneous layers that Adrenaline can play ultimately depends on what each layer is and how much effects processing is called for in each. On a 2.8GHZ test system, I consistently could preview five layers and often got up to eight.

When working with SD media, Adrenaline has little onboard processing (until HD expansion capability is added this year). Intel and the OpenGL graphics card do most of the heavy lifting. It does have professional I/O, including four-channel XLR audio in and out, as well as AES/EBU and S/PDIF. Of course, it has professional BNC component video, S-Video, and composite and reference sync, in addition to LTC timecode and two 1394 ports, a 4-pin and a 6-pin.

The FireWire ports hold a lot of Adrenaline's power. The 6-pin connector is the link to the Media Composer workstation, carrying digitized video and audio back and forth from Adrenaline to the CPU. The 4-pin port connects to a DV camcorder or deck. Adrenaline hardware does the encoding and decoding for both capturing media and displaying it on a preview or output monitor. Adrenaline maintains accurate clock and timing control so that any preview is locked to the position of the sequence-window play bar.

Off-loading digitizing and encoding from the CPU is a huge advantage. It allows the host computer to work directly on number crunching in the sequence window, particularly with DV material, which would otherwise need to be uncompressed and recompressed constantly. Media Composer processes video in YUV rather than RGB, so the CPU doesn't have to waste time on those peripheral operations. Instead, the CPU can work through effects and transitions in real time. The system graphics card also has started to play a major role in Media Composer's real-time performance because, just as with 3D modeling preview, Composer can leverage the redraw capabilities of the card, again freeing the CPU.

There is a surprising dearth of visible changes in the software interface with the addition of Adrenaline; admittedly, a great deal of work took place under the hood. One interesting development is a nice visual aid for the real-time preview. It's a feature that Composer borrows from its younger sibling, Avid Xpress.

Because the real-time preview depends on the CPU's ability to perform any variety of timeline operations, Avid offers feedback to help users achieve efficient preview. If the system begins to reach its maximum during preview and is in danger of dropping frames, a yellow line appears beneath the Sequence. If the system actually drops frames, a red or blue line tells the user that the problem is either the CPU or slow disk access. A new draft mode enables users to reduce the preview quality in favor of displaying even more layers in real time.

A wonderful new work flow feature is Adrenaline's program-length color correction. Color correction isn't new, but now Media Composer will match a reference color or colors through an entire sequence, potentially saving a lot of manual work. And Avid opened its architecture to plug-ins, enabling the addition of new features.

Media Composer users may not notice a lot of changes to the interface—that is, until they start editing and adding layers. It's there that Adrenaline shows its value. It frees not only the user from proprietary hardware, but also the CPU to do more editing. And it sets the course for the future.

Jeff Sauer *is a freelance writer, video producer, and director of Digital Video Group, an independent testing and research organization for digital media.*

stats

Media Composer Adrenaline

Price: $24,995

Minimum System Requirements: Windows XP Professional with Service Pack 1 or Mac OS X, 1GB system memory, a qualified graphics card, an IEEE-1394 FireWire port, 40GB internal disk drive, and a DVD-ROM drive

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IBM IntelliStation Z Pro

IBM offers a high-performance system

By George Maestri

Equipped with a high-end graphics accelerator, the IBM Intellistation Z Pro performs well in production.

The IBM IntelliStation has become a popular sight in studios around the world. The machine always has been a sturdy and reliable performer. The IntelliStation Z Pro offers a number of new features, including faster processors, Gigabit Ethernet, and an efficient design.

The review machine came configured with dual 3GHZ processors, 2GB of RAM, and a 3Dlabs Wildcat 7110 graphics card. Given its two 80GB, 7200 RPM drives, storage was more than ample; the machine also had a CD-RW drive. At the time of publication, IBM announced the availablity of 3.2GHZ processors for even more speed.

The IntelliStation's case is reasonably compact, and small enough to be turned on its side and rackmounted. No fancy doors or pastel faceplates exist on this machine. Like a Model T, it is black, utilitarian, and functional. The system has two full-size external drive bays, one of which holds the CD drive. Another external bay holds the floppy drive. The front of the machine has a 4-pin FireWire connector, along with two USB and audio in/out ports. I particularly like having a FireWire connector on the front, as it makes it easy to plug a camcorder into the box without moving the whole machine.

The back of the machine is richly configured with standard serial, parallel, USB, and audio connectors. A 6-pin FireWire connector and a Gigabit Ethernet connector also grace the back of the unit.

Getting to the guts of the machine is easy. The side of the case removes at the flip of a lever, revealing a nicely organized interior. The CPUs are housed underneath two very large, passive heat sinks. Two large external fans and a plastic duct pulls air through the case and over the CPUs to provide cooling. It is a much better solution than the standard remedy, which places the fan on top of the heat sink and simply recirculates the hot air already in the case.

One interesting note is that the motherboard has two SCSI connectors along the front edge. Normally, these are used for internal drives, but an external SCSI connector would have been nice. Those using external RAIDs and other SCSI devices will have to install a third-party cable and connector for external SCSI functionality.

The machine has three internal hard-drive slots. The drive cages are angled so that the drives are inserted and removed over the surface of the motherboard. This is cumbersome, as the drives need to be gently slid out over the memory cards and a couple heat sinks. If the machine was a bit wider, IBM could have turned the drives 90 degrees to face the user, making service much easier.

The unit has one AGP and five PCI slots, allowing for plenty of upgrade room, and an innovative flip-out plastic shield, which holds in the cards without the need for screws. Also inside the case is a reasonably nice speaker, which saves users the headache of buying an external speaker system.

The system was bundled with Windows XP Professional, yet it is capable of running Linux. Once powered up, the IntelliStation Z Pro is fairly quiet, although the fans seem to have a slightly higher pitch than other machines. It could get a little annoying if the machine were on a desk right next to me all day. Tucking it under the desk masks the sound completely.

The computer came configured with a 3Dlabs Wildcat 7110, certainly one of the best cards on the market. The card offers 256MB of video memory and supports dual monitors for a maximum resolution of 1920x1080. As with many high-end graphics cards, the Wildcat uses two card slots, effectively taking one PCI slot out of commission. The card has two DVI connectors on the back for driving analog monitors via a supplied adaptor.

I tested graphics performance using Viewperf 7.1. The Wildcat came in with a 3ds max score of 16.4, a Pro/E score of 19.2, and a UGS score of 18.5—all very close to the results posted on the Viewperf Web site. For those wanting faster graphics, the Nvidia GeForce FX 2000 and FX 3000 are available with the IntelliStation.

Testing CPU performance with SiSoft's Sandra benchmark suite, I got a CPU score of 11967 mips, which I expected for a dual 3GHZ system. Memory was very fast at 1.4GB/sec. The drives were fairly fast and, upon inspection, I noticed they were striped as RAID 0 for additional speed. For those who work with large files, such as video, IBM offers SCSI drives for additional performance.

Overall, I really liked the IntelliStation Z Pro. At a price of $7195, it's certainly not cheap, but the machine is very high quality and configured with a fairly expensive graphics card. With a base price is $1989, the system has plenty of options for customization. It is very well designed and would fit well in just about any studio or production environment.

stats

IBM IntelliStation Z Pro

Price: $7195 as tested, $1989 base

Minimum System Requirements:
Not applicable

IBM www.ibm.com infoNOW 135

George Maestri *is president of Rubberbug, a Los Angeles-based animation studio specializing in character animation.*

DreamScape and AfterBurn

Plug-ins add power to 3ds max

By Doug King

AfterBurn Version 3.0 includes several new and enhanced features with which to create eye-catching effects.

Sitni Sati upgraded DreamScape to Version 2.0 and AfterBurn to 3.0. Available for purchase from Turbo Squid, both new editions are tightly integrated into the Discreet 3ds max core program, working hand-in-glove with its many components.

DreamScape offers a suite of modeling and animation tools for building complete environments with realistic skies, 3D clouds, and beautiful bodies of water. The program comes with such objects as DreamScape Terrain and SeaSurface, lights, atmospherics, materials and maps, space warps, and daemons (helper objects that affect the objects and volumetrics in DreamScape, as well as in AfterBurn).

Among DreamScape's new features are enhancements to the Terra editor, including instant mesh preview inside the viewport and support for MAX script and pressure-sensitive digital tablets. The new Terrain Map includes a falloff parameter for smooth transitions between regions defined by altitude and/or slope. The sky and cloud tools have been upgraded to include 3D clouds, full sky and cloud antialiasing, and a reduction in rendering time of up to 50 percent. DreamScape Terra also uses new rendering technology that occupies less of the computer's RAM, enabling users to render very large, detailed terrains.

New daemons make it possible to write a helper object that can communicate with SeaSurface and perform various calculations using internal data. This feature enables ship models, for example, not only to interact with the ocean perfectly, but also to cause secondary effects, such as wake and spray.

Always a fan of terrain-generating tools, I found DreamScape to be intuitive, powerful, and able to generate excellent results. In comparison to other terrain-creation tools, Version 2.0 is much easier to use, and I was able to produce the results I desired in less time. Yet, if I were to compose a wish list for future features, I would request the ability to create waterfalls and to add surface vegetation. For anyone who needs to build realistic and fantastic terrain models, Dream-Scape 2.0 should top the list of must-haves.

Another new release, AfterBurn is a popular and powerful advanced volumetric particle effects engine plug-in. Used in such films as *Armageddon*, *Dracula 2000*, and *K-19*, AfterBurn turns standard 3ds max particles into realistic smoke, clouds, explosions, and other organic fiery and gaseous effects. The software is designed to work in concert with the integrated 3ds max particle systems to augment the effects and allow users to create stunning visuals for film and games that could not otherwise be created with native particles.

Using volumetric "puffs" that surround each individual particle, AfterBurn can turn a simple Superspray into a fiery rocket exhaust, or a Snow particle system into an atomic explosion, easier and quicker than ever before.

New features in Version 3.0 include the addition of Bézier curves to Animation Flow Curves, providing users greater control over how the flow curves appear. The Gradients dialog includes new TCB (tension, continuity, and bias) controls, which are used to affect the color of the volumetric puffs. As a result, users can set fewer flags and still achieve incredible results.

In previous versions, Animation Flow Curves were based on the individual particle's age. Now, users have the ability to choose from Particle Age, Velocity, Emitter Distance, Object Distance, and Expression based on interpolation methods, freeing them to create amazing effects that would have been impossible before. The Explosion Daemon now offers a number of new color-blending options, including Add, Multiply, Replace, and Intensity Blend, so that users can achieve greater realism.

Version 3.0 offers so much more, including speed and performance enhancements and reflections for rendering particles as convincing fluids. As with DreamScape, most of the work done in AfterBurn is completed inside the Render/Environment/Atmospheric dialog. Anyone familiar with this dialog will find both programs easy to learn and use. Upon opening an AfterBurn Atmospheric effect, the user is presented a seemingly endless rollout of options. It might prove daunting at first, but the controls are intuitive and, with a little experimentation, easy to use. For those who work with particles and need to create realistic effects, AfterBurn is an excellent choice. It's simple to use and understand, but offers enough controls for users to create stunning unique visual effects.

Doug King, *a contributing editor based in Dallas, Texas, develops animated projects for his company, Day III Productions.*

stats

DreamScape 2.0 and AfterBurn 3.0

Price: $595 and $495, respectively

Minimum System Requirements: Discreet 3ds max, 256MB of RAM, and 5MB to 20MB hard-disk space

Turbo Squid
www.turbosquid.com
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products

For a direct link to more product information and vendor Web sites, click on: www.onlinecenter.to/cgw

SOFTWARE

EFFECTS

Digital and Downloadable

Win • Mac Described as an offshoot of Digital FilmWorks, a full-service visual effects facility in Los Angeles, Digital Film Tools has unveiled 55mm 3.0. The suite of plug-ins comprises a collection of digital optical filters for use with Apple's Final Cut Pro, Avid editing systems, and Adobe's Photoshop, After Effects, and After Effects-compatible programs running on Windows or Macintosh operating systems. Black Mist, Black & White, Bleach Bypass, Color Correct, Cool Mist, Diffusion, Faux Film, Fog, Glow, Mist, Ozone, Polarizer, and Streaks are among the many plug-ins offered in 55mm 3.0. The new release is available for download at a cost of $145 for the Photoshop version and $295 for all other editions. Customers can upgrade to Version 3.0 at a special upgrade price of $45 to $95.

Digital Film Tools; *www.digitalfilmtools.com*

infoNOW 136

Discreet Debut

Irix Discreet has upgraded its inferno, flame, and flint compositing and visual effects software solutions. Discreet's inferno 5.5, flame 8.5, and flint 8.5 are scheduled to begin shipping early this year. All three upgrades benefit from Discreet's Master Keyer with GMask gradient technology, 10-bit media support, Colour Warper enhancements, expanded Burn-In and EDL Editor tools, and more. The HDTV archiving capabilities of inferno and flame now include support for 720P tape decks. Customers having a valid, paid Level 1, 2, or 3 Discreet Support service contract at the time the new versions ship will receive the upgrades at no extra charge.

Discreet; *www.discreet.com*

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STOCK OPTIONS

ROYALTY-FREE AND HD

Artbeats Software has added new titles to its burgeoning library of royalty-free, high-definition (HD) stock video footage. To deliver high-quality, uncompressed footage, Artbeats not only telecines all film to HD using a digital direct-to-disk method, but also retouches the footage frame-by-frame to remove artifacts. The company's newest HD collections are *Chicago Aerials HD, Volume 1 & 2*; *Farmland Scenics HD*; *Mountain Peaks HD*; *Reel Explosions HD 2*; *Rural Lifestyles HD*; *Winter Lifestyles HD*; and *Winter Scenes HD*. Offered in 1920x1080 resolution and ranging in price from $799 to $899 per title, each HD collection includes 10 or more clips licensed for all uses, including broadcast, feature film, multimedia, and Internet. For example, *Mountain Peaks HD* offers 37 aerials of the Cascade Mountain Range and *Chicago Aerials HD, Volume 1 & 2* is a 41-clip collection providing views of the Sears Tower, Hancock Observatory, and other landmarks.

Artbeats Software; *www.artbeats.com*

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SUPPORT

Point-of-Need Purchase

Intelligent Assistance, maker of multimedia support tools for digital media artists and content creators, has launched Assistance on Demand. An online, on-demand service, Assistance on Demand provides creatives with real-time product support and technical guidance. Users can purchase expert support by way of streaming video clips or text as needed. Assistance on Demand also offers live classes via live streaming, movie push, and Instant Messaging. Simpler How2s begin at a cost of 25 cents, whereas in-depth tutorials on complex issues are priced at up to $9.95. An initial $1 account set-up charge also applies.

Intelligent Assistance;

www.assistanceondemand.com

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HARDWARE

WIRELESS

USB Debut

Gefen introduces the USB-500, the company's

latest innovation which takes advantage of "Extreme USB" technology. The USB-500 extends the functionality of virtually any USB device, including a keyboard and mouse. Whereas USB devices typically are limited to a distance of 17.5 feet, the USB-500 extends the reach of connected devices to a maximum of 1650 feet from the computer. The system incorporates a USB-500S Send Unit, a USB-500R Receive Unit, two 15-volt power supplies, and a six-foot, A-to-B USB cable. The unit also boasts a four-port USB HUB.

Gefen; *www.gefen.com*
infoNOW 139

GRAPHICS PROCESSORS

Power to Mobile Professionals

Nvidia has amended its GeForce FX Go series of GPUs for mobile PCs with the GeForce FX Go5700. The new addition combines enhanced geometry and rendering performance with the company's Ultra-shadow technology to achieve cinematic 3D graphics, whereas high-definition component video-out and HDTV support help deliver high-quality video. Its Unified Driver Architecture ensures compatibility with an existing work flow, and PowerMizer 4.0 with Nvidia SmartDimmer extends battery life through power management. Systems incorporating the Nvidia GeForce FX Go5700 are expected to begin shipping this quarter.

Nvidia; *www.nvidia.com*
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High-Performance Processor

ATI Technologies has introduced its Mobility FireGL T2 mobile workstation processor, which is shipping in the HP Compaq nw8000 and IBM Thinkpad R50p and T41p. Well-suited to digital content creators, the Mobility FireGL T2 is designed to deliver fast geometry processing, realistic rendering, and optimal application performance. Based on the FGL 9600 VPU, the new processor features OpenGL and DirectX 9 drivers, 128MB of high-speed DDR memory, dual monitor support, and ATI's SmartShader, PowerPlay, and Power-on-Demand technologies.

ATI Technologies; *www.ati.com*
infoNOW 141

events

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Emerging 3D Applications & Opportunities 2004, held in San Jose, California. Contact Acacia Research Group, www.acaciarg.com

MARCH

22–26

Game Developers Conference (GDC) 2004, held in San Jose, California. Contact www.gdconf.com

APRIL

17–22

NAB2004, held in Las Vegas, Nevada. Contact National Association of Broadcasters, www.nab.org

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it had to be played just right and composited just right. There was a lot of lava involved, a lot of camera work, and a lot of elements that went above and beyond the animation problem. It's operatic and quite breathtaking. It's a fitting end to the trilogy.

Q ***Did you advocate a particular style of animation?***

A We tried to put real acting values into a character who happened to be animated, but also we tried to put the Ray Harryhausen and Willis O'Brien-esque spectacle of the past into the present day. Whether the character was as complex as Gollum or as simple as a cave troll, we tried to think of them as characters, not animated characters. So any problem of staging was solved by movie solutions, not animation solutions. We made acting choices, not animation choices. We tried to do a different kind of more heroic acting than the musical comedy stuff that seems to be the norm for animation.

Q ***What do you mean by musical comedy animation?***

A There's a school of animation that is analogous to Broadway musical comedy acting, and it has become a standard in animation acting. So many animators have been affected by this overstated style of acting, which is appropriate for a children's picture or musical. However, we tried to stay away from that sort of approach. It might seem that when you're watching the movie it wouldn't be a consideration, but when you're working with animators, and their default response to a problem is to do an arched eyebrow or an anticipatory movement, it becomes a talking point.

Q ***How does it feel to be finished?***

A I haven't come to terms with this thing being over yet. When I delivered the last shot, I completed a five-year chunk of my life. Many people thought this was a mad quest; that such a feat could not be achieved. It took a huge collaboration of talent to realize this impossible dream. I've participated in a movie classic that will live long after us, and for that I feel humbled and privileged. I'll have a slow decompression between now and March, while we work on the DVD. New Zealand is a nice place to be in the summer.

backdrop

Interview by contributing editor
Barbara Robertson

The Lord of the Rings: The Return of the King *animation supervisor* **Randall William Cook** *won Oscars in 2002 and 2003 for animation and creature effects design and supervision on* The Lord of the Rings: The Fellowship of the Ring *and* The Lord of the Rings: The Two Towers.

Epic Animation

***The Lord of the Rings* films have set new standards for CG character animation in live-action films**

Q ***When did you start working on the* Lord of the Rings *films?***

A I was brought in originally to help director Peter Jackson design action sequences for the first film and was in charge of previz in 1998. Together, we designed the cave troll sequence and the sequence on the stairs of Khazad-Dum.

Q ***What was it like to work with Peter Jackson?***

A Peter had his finger in every imaginable pie here. He was a versatile, multitalented moviemaker. He initiated the project and oversaw every facet of it in a way that I think is the ideal way to make movies as long as you have a director with insight and vision.

Q ***Why do you think the films are so successful?***

A These films don't try to be *Mad Magazine* at the same time they're telling a story; there aren't wise-cracking sidekicks. Peter took a classical and traditional moviemaking style that is highly kinetic and reinforced a notion, which had been out of favor, that a story can be told with complete sincerity without worrying that you'll lose the audience unless you inject cheap humor.

Q ***How many animators worked on* The Return of the King*?***

A We grew from a crew of 12 animators at Weta Digital on the first film to 45 on the third one. We delivered 590 animation shots, many with multiple characters.

Q ***How do you think your training as a stop-motion and traditional animator, actor, and director influenced the animation crew?***

A I learned a lot of things from special people: Ray Harryhausen, Tex Avery, Eric Larson at Disney, and others. I felt that I was a bridge between that generation and the next one, and I tried to infuse into the animation crew a unity of taste and performance that they might not have found elsewhere.

Q ***How did the work on* The Return of the King *differ from the first two films?***

A This is act three of the story, the climax, so many things had to come together. The scope is far greater and there are more characters in this film than in the other two combined, so it became, dramatically and from a showmanship point of view, grander, more intense, and faster than the others. And, Gollum's emotional arc had to be intensified. His character had to reach a peak that was only hinted at in the second film. We strove to keep the quality and better it, but also simultaneously, we had to top ourselves on every level in terms of spectacle and emotion. It was always the plan; that was the job: Make part three bigger, better, more emotional, more epic.

Q ***What technical advancements contributed toward making the third film more spectacular?***

A We did motion capture for Gollum on the set, and that was quite successful for action/interaction moments. But, the advancements were more in developing the craft of the team than in the actual technical advancements. We had some of the best animators on the planet at the top of their game, and they needed to be.

Q ***Why is Gollum so successful?***

A I think he's a successful character first and foremost, which makes the technical side easier. If Gollum had not been compelling, all the technology in the world wouldn't have made him interesting or watchable. Fortunately, he was successful on every level, from the writing to the acting by Andy Serkis to the performance by the animators under Peter's direction to the synthesis of his skin and flesh and eyes and hair...everything.

Q ***Was Gollum's death scene particularly difficult?***

A The scene was very complicated. It was a very big performance, a big spectacle shot, and

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