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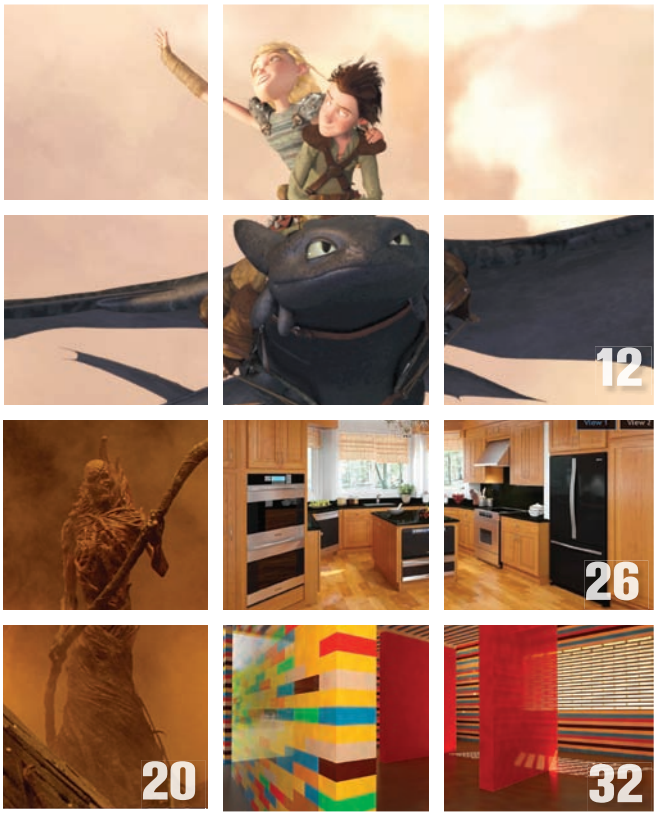

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ON THE COVER

The young Viking Hiccup, atop the friendly dragon Toothless, battles the mother of all dragons and the source of bane for the humans and dragons alike in DreamWorks' new CG animated feature *How to Train Your Dragon.* See pg. 12.

It's All A Game

San Francisco became the central hub for gaming last month as the Moscone Convention Center hosted the annual Game Developers Conference (GDC). At one point several years ago, GDC seemed to be having a tough time of things, as the San Jose show floor got smaller and the sessions became fewer. But, with the move to San Francisco a few years back, GDC exhibited a comeback, a renewal of sorts. The panels were extensive, and the topics interesting and relevant. The show floor hosted far more vendors. This year was no different.

At one point, GDC was focused solely on computer games, but more recently the gaming industry has extended its reach into other segments of the market. Consoles, like their PC counterparts, have been a major focus for developers at the show, especially following the introduction of the sixth-generation consoles (Dreamcast, GameCube, Xbox, and PlayStation 2). When the current generation of machines was introduced, game development became a more complex process, requiring similar cutting-edge tools and techniques as films. Tool vendors were happy to be such an integral part of game development, and soon they were filling the conference floor to hawk their wares, while top-level game studios were eager to share their trials and triumphs.

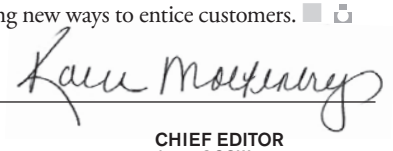
Today, gaming stretches far beyond the PC and console to handheld devices, the Web, and cell phones. In fact, this year's conference was heavily focused on mobile graphics and causal games. And that's hardly surprising. For years, mobile gaming has promised 3D applications, though they have been a long time coming. But now, their time has come, thanks to devices such as smart phones. Think about it. The smart phones that are available today are more technologically advanced than most computers were not that long ago. The most popular, of course, is Apple's iPhone, which seems to offer everything a person wants: a built-in camera, an Internet client for e-mail, Web browsing, Wi-Fi connectivity, and, of course, mobile phone capabilities. Its biggest attraction is its multimedia functionality. While the iPhone is not the only smart phone available, it does have something that most other devices do not have: apps. Indeed, there appears to be an app for just about anything and everything. And this has not escaped the notice of mobile game developers. At this year's GDC Mobile/Handheld mini-conference, games for these devices—from the iPhone to the Blackberry, Android, and more—were at the top of the topic list. As experts there noted, 2010 will continue to see the rise of mobile offerings as phone carriers overcome the obstacles (format issues, distribution problems, and so forth) that have hindered this genre.

A similar revolution has occurred on the Web with the casual gaming phenomenon. While many believe the big-name console titles to be the most popular choices for gamers, think again. Casual gaming is redefining the typical "gamer" with a wide range of arcade, puzzle, board, and card games that have made the leap to the virtual world. Not convinced? Just search for these titles—*Scrabble, Sally's Salon, Bejeweled 2, Jewel Quest*, and *Monopoly*—and you will find a host of players (and a ton of fun, too).

These casual games have opened a new genre: social gaming. Even though gaming on the social site Facebook has been around for a few years, last year saw a big boom. Case in point: Do you play *Mafia Wars* or *Farmville*? If not, chances are good that you will. Current predictions are that social gaming will reach $5 billion in a few short years. Some, though, are treading more cautiously in their predictions for this new emerging market. David Cole, an analyst with DFC Intelligence, is predicting a resurgence in casual gaming for this year, citing revenue sources from virtual goods as opposed to advertising. Social gaming, he points out, has a precarious ad model whereby users must sign up for promotional offers. As he states, that begins to feel like spam—and we all know how people feel about that.

One of the biggest changes at GDC during the past decade or so was the formation of the Serious Games Summit. This year, that mini-conference drew a host of attendees seeking insight and direction for applying popular gaming strategies to real-world training initiatives. What started with *America's Army* has now expanded into virtual every segment, from health and education to national defense and science.

This year's GDC can be called "a success." It exhibited a record number of attendees (more than 18,000), when nearly every other industry conference experienced record lows. Perhaps this is due to gaming's ability to bob and weave, and to continue finding new ways to entice customers.



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Autodesk Readies Its 2011 Releases

Autodesk has revealed 2011 product versions of its digital entertainment creation software, including Maya, 3ds Max, Softimage, Mudbox, and MotionBuilder—all of which offer features for increased production efficiency. The products offer new features and enhancements that help accelerate workflows and improve data interoperability through formats such as Autodesk FBX, helping artists to maximize their creativity and optimize their productivity. In addition, Autodesk has launched new versions of its Kynapse and HumanIK game development middleware, focusing on improved ease of use.

On the heels of the Maya 2010 makeover last summer, Maya 2011 features a customizable user interface, enhanced tools for character animation, including non-destructive live retargeting, high-performance display of large scenes in the viewport, new 3D editorial capabilities for pre-visualization and virtual production workflows, integrated color management, asset structures for pipeline connectivity, and improved rotoscoping. Also, Maya 2011 is now available for Snow Leopard, the 64-bit Mac OS X operating system. Maya 2001 is priced at $3495 for a stand-alone license; an upgrade from Maya 2010 costs $1745.

3ds Max 2011 sports a new node-based material editor—the feature most requested by users—and a high-quality hardware renderer that provides near-production-quality results 10 times faster than traditional rendering techniques on common graphics cards. It also offers a tightly integrated, full-featured high dynamic range compositing system (based on Autodesk Toxik technology), as well as enhanced tools and workflows for creating and texturing models, animating characters, and viewing high-quality images interactively. A 3ds Max 2011 stand-alone license costs $3495; an upgrade from the 2010 version of 3ds Max or 3ds Max Design is priced at $1745.

Softimage 2011 introduces new rendering and animation tools for creating more complex, high-quality characters and effects faster. The software offers a novel advanced shading architecture and editing environment, an innovative rigging paradigm with support for kinematics in ICE (Interactive Creative Environment), and automated lip synching in the Face Robot facial animation tool set. A Softimage 2011 stand-alone license carries a price tag of $2995; an upgrade from Softimage 2010 is set at $1495.

Mudbox 2011, priced at $745 for a stand-alone license, delivers new tools for helping to deform and pose models. It also offers new image adjustment brushes and blend modes for paint layers, vector displacement map extraction, the ability to create higher-quality turntables, and enhanced file transfer with Maya and Adobe Photoshop.

Offering significantly improved interoperability with Maya 2011 and 3ds Max 2011, MotionBuilder 2011 now integrates more smoothly and reliably into production pipelines. Skinning and blendshape deformations are calculated on the GPU for improved performance. The in-viewport experience is significantly more interactive, and playback is many times faster, further enhancing the software's capabilities as a real-time virtual production system. The new version is priced at $3995.

Additionally, Autodesk's FBX 2011 asset exchange technology helps facilitate higher-fidelity data exchange between Autodesk software and certain third-party applications. The open format provides new support for additional third-party and proprietary applications. In addition, game developers using Epic Games' Unreal Engine 3 will be able to import FBX files directly into the Unreal Editor. Developers can use the Python programming language to integrate FBX technology into pipelines not based on C++. FBX 2011 is offered free of charge and can be downloaded at http://usa.autodesk.com/adsk/servlet/pc/index?siteID=123112&id=6839916.

These new products also will be available as part of the Autodesk 2011 Entertainment Creation Suites. The suites, priced at $4995, offer a choice of either Maya 2011 or 3ds Max 2011, and include MotionBuilder 2011 real-time character animation software, as well as Mudbox 2011 digital sculpting and 3D painting software.

In further news, Autodesk is offering HumanIK 4.5, animation middleware for full-body inverse kinematics and retargeting that enhances existing animation systems, allowing characters to interact dynamically and realistically with their environments. HumanIK 4.5 improves ease of use with an artist-friendly integration into the Unreal Engine and a Characterization plug-in for creating and validating characters in Maya. Pricing is unavailable at this time.

Autodesk, meanwhile, upgraded its Kynapse middleware to Version 7. An artificial intelligence solution that supports complex dynamic 3D pathfinding, spatial reasoning, team coordination, and automatic data generation, Kynapse is now easier to use, with new pathdata generation, improved tuning and profiling, simplified integration and configuration, as well as off-the-shelf behaviors. Pricing for Kynapse will be announced at a later date.

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The Foundry Launches New Nuke

Leading visual effects software developer, The Foundry, has rolled out the much-awaited Nuke and NukeX 6.0, following feedback from artists and production analysis by an in-house research team.

Offering VFX users two different Nuke products enables facilities of all sizes to implement a Nuke solution to fit a range of artist and customer needs. Nuke continues to be an evolving, flexible solution for a multitude of visual effects tasks, while NukeX brings previously inaccessible tools and workflow options to compositing artists, saving time and increasing the quality of their work. Nuke and NukeX are fully script compatible, with Nuke capable of viewing and rendering nodes created using the extended NukeX tool set. Nuke 6.0 incorporates a new shape rotoscope and paint tool set based on a rewritten core curve library and new RotoPaint node. The release introduces a flexible, non-destructive, layer-based paint hierarchy integrated with Nuke's animation and tracking capabilities, and support for per-object attributes, such as blending modes and motion blur. Additionally, The Foundry's Keylight blue/green screen keyer—especially tuned for tackling reflections, semi-transparent areas, and hair—is now a standard feature in Nuke 6.0. NukeX 6.0, meanwhile, extends the range of tools usually found in the compositing environment, adding an integrated 3D camera tracker, automated and manual lens distortion tools, FurnaceCore (The Foundry's re-engineered set of the Furnace plug-ins), and a DepthGenerator plug-in.

Both Nuke 6.0 and NukeX 6.0 are now available for $3500 and $6000, respectively.

PRODUCT: COMPOSITING

Graphics Card Growth Exceeds Expectations

Jon Peddie Research (JPR), the industry's research and consulting firm for graphics and multimedia, found that figures for estimated graphics chip shipments and suppliers' market shares for the fourth quarter of 2009 came in above expectations, with a 14 percent year-to-year growth—an amazing comeback in this year of retrenching and recession.

Intel was the leader in fourth-quarter 2009, elevated by Atom sales for netbooks, as well as strong growth in the desktop segment. AMD, meanwhile, gained in the notebook integrated segment but lost some market share in discrete sales in both the desktop and notebook segments due to constraints in 40nm supply. Nvidia picked up a little share overall. Nvidia's increases came primarily in desktop discretes, while slipping in desktop and notebook integrated.

AMD reported revenue of $427 million from its graphics segment for the quarter, up 40 percent sequentially. AMD's graphics segment reported an operating income of $53 million, a substantial improvement from the prior quarter.

Intel reported revenue from chipset and other revenue of $1.877 billion in the quarter.

Nvidia's quarter, which straddles the calendar quarters, reported revenues of $903 million for its fiscal Q3, which is from August to the end of October. The firm's next quarter ended in January.

Fourth-quarter 2009 saw the first shipments of a new category, CPU-integrated graphics (CIG). With the advent of new CPUs with integrated or embedded graphics, we will see a rapid decline in shipments of traditional chipset graphics, or IGPs (integrated graphics processors).

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Graphics Chips:	180.6	217.1	239.0	269.4	316.5	351.7	373.0	425.4	544.0	600.1
Annual Percentage Growth	20.6%	20.2%	10.1%	12.7%	17.5%	11.1%	6.1%	14.0%	27.9%	10.3%

Growth rates from 2002 to 2011.

Vendor	This Quarter Market Share	Last Quarter Market Share	Unit Growth Quarter to Quarter	This Quarter Last Year Market Share	Growth Year to Year
AMD	19.9%	20.1%	13.6%	19.3%	91.5%
Intel	55.2%	53.6%	17.9%	47.7%	114.7%
Nvidia	24.3%	25.3%	10.2%	30.6%	47.3%
Matrox	0.0%	0.0%	66.7%	0.1%	-16.7%
SiS	0.0%	0.3%	-81.8%	1.1%	-92.5%
VIA/S3	0.6%	0.7%	-3.9%	1.2%	-9.5%
Total	**100.0%**	**100.0%**	**14.7%**	**100.0%**	**85.7%**

Recent market growth.

The fourth-quarter 2009 edition of Jon Peddie Research's "Market Watch" is available now in both electronic and hard-copy editions, and can be purchased for $995. Visit JPR's Web site at www.jonpeddie.com.

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Wacom Offers New Cintiq 21UX

Wacom recently introduced its Cintiq21UX, its newly redesigned interactive pen display designed to meet the needs of professional photographers, designers, artists, and animators.

The Cintiq 21UX captures the slightest nuance of pen pressure against the LCD surface and offers 2048 levels of pressure sensitivity. Rear-mounted Touch Strips are ideally placed for fingertip access while working. Each Touch Strip has an accompanying thumb-controlled Touch Strip Toggle button that controls as many as four user-assigned functions per application, such as zoom, scroll, brush size adjustment, and canvas rotation.

A patented stand allows users to recline the pen display at any angle between 10 and 65 degrees to match the user's ideal working posture. In addition to reclining, the Cintiq 21UX can be rotated up to 180 degrees in either direction to take advantage of natural drawing movements or offer a different viewing angle. The Cintiq can be removed from the stand for use on a tabletop or to attach it to an articulating arm (not included).

The Cintiq 21UX ships with a number of software packages, including Corel Painter, Nik Color Efex Pro 3.0, and Wacom Brushes 3.0. It is priced at $1999.

PRODUCT: PERIPHERALS

PC Gaming Hardware Forecast to Reach $27 Billion

Jon Peddie Research (JPR), the industry's research and consulting firm for graphics and multimedia, has revealed the market forecast for PC gaming hardware, and the results are better than previously expected.

The worldwide PC gaming hardware market (including systems, accessories, and upgrades) is forecasted to have gained $1.2 billion in 2009, a 5.9 percent increase versus 2008 (from $20.07 billion to $21.26 billion). The increase is due to higher-than-anticipated consumer demand for enthusiast, performance, and mainstream hardware influenced by the ability to play video games ranging from casual to hard-core simulations.

Due to significant growth across all major markets, the worldwide PC gaming hardware market is expected to skyrocket 30 percent in 2010. JPR senior video game industry analyst Ted Pollak credits this growth to a number of factors. "The largest influence on the high forecasted growth rate is due to purchasing delays for systems and upgrades in 2008/2009 as consumers circled the wagons and took a conservative position on discretionary spending," he says. "A recovering economy, processing advancements, and higher-quality gaming offerings will all contribute to a healthy year for PC gaming hardware in 2010."

Year	2008	2009	2010	2011	2012
Total PC Gaming Hardware Market	$20,076	$21,260	$27,617	$32,749	$34,760

As JPR president Jon Peddie points out, the personal computer gaming market continues to be the high-growth area and technological leader for home entertainment. "With Windows 7 and DirectX 11, advanced and exciting physics, and stereovision capabilities, the PC platform is far and away the most advanced," he notes. "And, the PC has the added advantage that when not used for gaming, it can serve more practical purposes and double as a media center."

JPR uses a complex methodology to pinpoint the true global, total addressable market for PC gaming hardware, which is no easy feat given the multi-dimensional nature of personal computers. The result is a report series that is highly accurate and available by segment (enthusiast, performance, and mainstream) for companies not focused on all levels of PC gaming. The report covers all major regions and provides detail for the top 37 countries.

The "Worldwide PC Gaming Hardware Market" report series by Jon Peddie Research is available in three versions: enthusiast, performance, and mainstream, with each selling for $5000 and the set of three for $12,000. With the set is a summary report of the total hardware PC market worldwide.

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Fairy Good

Prime Focus created a range of visual effects for the film *Tooth Fairy*, including fairy wings, magic dust, and the surreal swirling vortex in the image above.

This past year, Prime Focus orchestrated massive naval battle sequences for *Red Cliff*, engineered destructive nanomites for *GI Joe: The Rise of Cobra*, gave Edward Cullen a Vampire sparkle in *The Twilight Saga: New Moon*, and designed 3D stereographic displays for *Avatar*. The studio rounded out 2009 with a little lighthearted fun by turning Dwayne "The Rock" Johnson into a magical childhood icon for director Michael Lembeck's Fox release *Tooth Fairy*, which hit theaters in early 2010.

In the movie, Johnson plays Derek Thompson, a violence-prone hockey player with a reputation for separating opponents from their bicuspids, earning him the nickname "Tooth Fairy." An unbeliever of magic, Derek is punished for his cynicism by having to spend a two-week sentence as a real tooth fairy, complete with tights, a tutu, and wings, all the while trying to hide his new appendages from his girlfriend.

Prime Focus was one of the primary visual effects vendors on *Tooth Fairy*, contributing 90-plus shots, the majority of which involved fairy dust simulations ranging from simple magic wand dust to a gigantic dust vortex that serves as the portal between our world and the fairy universe. The VFX team also created the majority of the CG fairy wings and handled some digital double and matte painting shots.

Art-Directing Fairy Dust

Creating the fairy dust was an interesting challenge for the team at Prime Focus. Director [Michael Lembeck] was looking for something beautiful and physical, yet magical, and the difficulty was in finding that balance. According to Chris Harvey, visual effects supervisor at Prime Focus, the crew experimented with hundreds of simulations, varying colors and quantities of sparkle versus powder and gravity. "Of course, there was the somewhat humorous yet very real concern that we didn't want to end up creating something that would spawn playground injuries caused from kids throwing things in each others' faces!" he says.

The artists designed several kinds of fairy dust for the movie—amnesia dust (which comes in handy after a human crosses paths with a fairy), the Fairy Queen's gold dust, and Derek's uniquely personal magical dust, for example. These all varied in color scheme, movement, design, level of sparkle versus powder, and how much weight they would have in terms of their own magic movement.

The fairy dust sometimes even became its own character. In one scene, Derek transitions from his pajamas into a fairy tutu, and fairy dust particles stream off him and back onto his body to form a new costume. "We were given 10 different plates of Derek in various stages of wardrobe," Harvey says. "After lining these plates up and warping them together, we used them to generate particles that stream off or onto Derek, to generate the costume."

There was also one scene in which Derek goes through a personal transformation—he starts believing and is no longer the cynical guy he once was. This empowers him with his own kind of fairy dust, and he gets playful with it, fashioning the particles into a guitar and creating dust that looks like the Northern Lights dancing across the bed of his girlfriend's daughter.

"Some of the most fun we had was during the fairy dust look-development," says Harvey. "Our artists set up a mini stage, where we spent a day shooting several cases of baby powder and Kraft glitter thrown in people's faces—most notably mine." This generated lots of HD reference footage for how the dust and glitter moved and caught the light.

Creating the Magical Fairy Wings

The artists also created the majority of digital wings for the film's lead fairy characters. These had to integrate seamlessly into scenes in which the actors were wearing practical wings, with a lot of cutting back and forth. Like the fairy dust, each character's wings had their own unique personality and character, and Derek had two sets—smaller wings when he was a newbie fairy, and as he grows more powerful, super wings.

"We went through a number of iterations during look-development, creating concept art all the way through to modeling, lighting, and rendering different animation styles. Some designs being considered included wings that were more muscular hockey-player type wings, or wings reminiscent of tattoo art," Harvey explains.

Harvey counts the group fortunate to be working with filmmakers who were particularly collaborative, and gave the artists a lot of input in terms of the creative direction. "We'd do the wings, and then the filmmakers would show our wings to the studio for sign-off," he says. "In the end, after that process of discovery, however, the filmmakers opted to stick with having

CG replacement wings that perfectly matched the practical wings so that from shot to shot, you wouldn't be able to tell the two apart."

One interesting note that came back from the filmmakers, Harvey recalls, concerned how the wings looked "'amazing, but that they looked too real and too practical, and needed to be more magical.' So while that was great feedback–that the shot was kicked back because it looked too real–we had to constantly maintain a balance between photorealism and a more magical aesthetic."

For *Tooth Fairy*, the artists also created digital matte paintings. In the pivotal scene in which a stadium roof opens and a giant dust vortex sucks Derek up and transports him into the pastel alternate universe known as Fairyland, they built the roof digitally, and re-projected and matte-painted it so they could then rip it apart. In addition, they created the digital debris flying about, and meticulously art-directed the swirling dust effect. Finally, they enhanced scenes in which Derek flies over a cityscape by augmenting the sky and atmosphere, as well as the city below.

The bulk of the work was done out of Prime Focus' primary North American VFX hub in Vancouver, British Columbia, with additional shots sprinkled across the facility's artists in Winnipeg, Manitoba. All told, the team comprised approximately seven 3D artists, six compositors, and two VFX supervisors working on the show from January until July 2009. The primary software packages used by the artists on this show include Prime Focus Software's proprietary high-volume particle system, Krakatoa, Autodesk's 3ds Max modeling software, and Eyeon Fusion for compositing.

The filmmakers shot the majority of the movie in Harvey's hometown of Vancouver. Mammoth Studios, one of the city's largest soundstages, served as the location for filming the Fairyland scenes, while the new Olympic ice rink provided the setting for the movie's action-packed hockey sequences. As someone who has been with Prime Focus since its days as Frantic Films VFX, going all the way back to 2003, "it's been exciting to be a part of the thriving Vancouver filmmaking scene and seeing how the industry has brought in so much talent and revenue to our city," Harvey says. "And being able to take my kid to the movie theater to watch something our team worked on is, of course, an added bonus."

The iconoclastic young Viking Hiccup rides the dangerous Night Fury dragon after befriending the creature that other Vikings considered an enemy. At right, Tuffnut, another teenager, will take some convincing.

Training Exercise

DreamWorks forges a new stereo 3D experience and brings a Viking world to animated life in a CG adventure-comedy

By Barbara Robertson

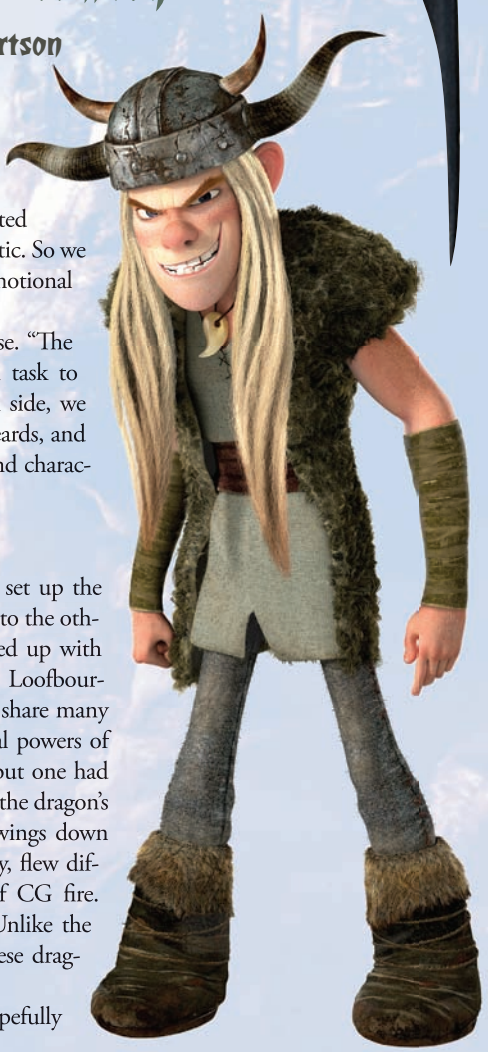
The title of DreamWorks Animation's latest film is *How to Train Your Dragon*, and indeed, the star of this animated feature, a teenaged Viking named Hiccup, does just that, albeit in his own way. So, it makes sense that the biggest challenges for the real-world animators, visual effects artists, modelers, and riggers centered on "training" CG tools to help the crew create these dragons. Seven dragons in all. Unique dragons devised by Annie Award-winning character designer Nicolas Marlet (*Kung Fu Panda, Over the Hedge*), who also designed the main characters for the film: Hiccup, his big-bearded father Stoick, a young female Viking named Astrid, and various other Vikings young and old.

Dean DeBlois and Chris Sanders, the team who wrote and directed Disney's *Lilo and Stitch,* directed *How to Train Your Dragon* and wrote the screenplay. It's the second film created in stereo 3D at DreamWorks from start to finish.

The story, based on the children's book by Cressida Cowell, pits the brainy Hiccup against his brawny dragon-slaying tribe: Hiccup breaks with tradition, befriends a dragon, and dubs his dragon friend "Toothless." The tribe is not amused.

Simon Otto, head of character animation, began working with Marlet, a design team, modelers, and riggers three and a half years before the film released, as part of a small development group that brought the two-dimensional drawings into the 3D world. "The design language of the movie pushed caricatured shapes set in a realistically textured world with live-action-esque lighting," Otto says. "We had exaggerated shapes, but the story is epic and naturalistic. So we needed to be sure we could deliver the emotional beats with realistic acting."

Production started a year before release. "The magnitude of the dragons was a main task to tackle," Otto says. "And on the human side, we wanted to make sure the Vikings had beards, and that created challenges for the rigging and character effects departments."



Dragon Power

At first, the riggers thought they could set up the controls for one dragon and apply them to the others, but it wasn't that simple. "We ended up with seven bespoke dragons," says Nathan Loofbourrow, character TD co-supervisor. "They share many controls, but each is unique with special powers of its own." They all had legs and wings, but one had spikes that move up and down based on the dragon's emotional state, and another puts his wings down and crawls. They each walked differently, flew differently, and spewed different forms of CG fire. And, they had different personalities. Unlike the dragon in PDI/DreamWorks' *Shrek,* these dragons are primary characters.

"We tried to hit a tone that was hopefully

At top, two Terrible Terrors illustrate the color range in this species of dragon, as they fight over a bit of food. At bottom, Hiccup shows his astonished yet dubious friends how to train a Monstrous Nightmare.

fresh," Otto says. "Dragons have been in many films, but they've mainly been in 2D or live-action movies, like *Dragonheart*. We didn't need to match a live-action design or match to plates, and we could make a more complex dragon than a drawing. Nico [Marlet] looked for a shape language—what a short, stubby dragon would look like, for example. We drew inspiration from real life and steered the designs into something naturalistic and recognizable for the audience. We wanted to have fun with them. Make them believable. And at the same time, somewhat silly in their nature."

The animators drew from personal experiences with their cats and dogs for Toothless. But, Toothless is also a dragon in the Night Fury species; a bird of prey, a panther, black like a stealth bomber, that fires white-hot lightning bolts. "Toothless has four legs, two sets of wings, a tail, and a tail fin," Otto says. "[For us] to have maximum artistic control, he had four times the number of controls as Hiccup, the main character."

The Deadly Nadder, on the other hand, has the muscular legs and aggressive nature of an ostrich and the beautifully colored feathers of a parrot. His tail is spiked, and he shoots swirling, white-hot sparkly shapes, but he doesn't see well.

Gronkle is a tubby, green dragon with tiny wings that Otto describes as a cross between a walrus, crocodile, bumblebee, and bulldog. "He's silly like a bulldog is silly," Otto says. "The dragons aren't funny as in a Tex Avery cartoon, but there is a funny aspect to their design and behavior that's drawn from real-life observation." Gronkle flies like a hummingbird, but scoops up rocks and turns them into lava balls.

Hideous Zippleback has two heads that zip together. One head spurts gas, the other head ignites it. The tiny Terrible Terror attaches itself to the larger dragons for free rides. "His fire is close to propane gas," says Craig Ring, visual effects supervisor. "The funny thing is that it's so out of scale for the dragon. It's like a 20- or 30-foot blowtorch." The red and black Monstrous Nightmare, which looks most like a classical dragon, sets itself on fire. Lastly, the Red Death is the biggest of all, in every way.

Rather than have the seven supervising animators be responsible for having their teams perform all the characters in entire sequences, Otto organized the supervisors and their teams by characters, using a system typically implemented for traditionally animated films. In addition, separate sets of animators worked on crowd scenes with armies of Vikings and big groups of dragons.

"Most of the supervisors were classical 2D animators who had worked at the studio for a long time," Otto says, "so we persuaded the studio to go back to a supervisor-per-character system." The supervisors led 51 animators at PDI/DreamWorks in northern California and at DreamWorks Animation in southern California. Although Otto noted that organizing the production by character rather than sequence can sometimes be more difficult to manage and less efficient, for this production that wasn't the case.

"It turned out that it helped us in the long run," Otto says. "Because the animators worked on one character, it was significantly more efficient, particularly with complex characters. And, the consistency of the characters grew as we went through the film."

Systems within the animation rig helped the animators handle that complexity.

Wings and Fire

"We spent a lot of time optimizing," Ring says. "The biggest problem was the complexity of the characters. For example, when you have hundreds of spikes on a dragon's back that can be moved independently, putting in controls that don't bog down the animators is a big challenge."

This film was the first to use the studio's rewrite of its in-house rigging system. "That definitely helped because it's faster," Ring says. "Also, we gave animators low-res proxy versions of dragons. They could turn off the parts they didn't need."

To help the animators control the dragons' wings, the riggers started by looking at movies of bats for reference. "Then we broke down the wings mathematically," Loofbourrow says. "Each wing had five, six, or seven divisions based on how they would fold up."

For each dragon wing type, the animators created flap cycles for different flying maneuvers—landing, coasting, and so forth. Then, the riggers added those flap cycles to the wing rig, and the animators could make the dragon fly using a few simple controls. "It was almost like they could turn a crank in the dragon and the wing would flap," Loofbourrow says. "They could dial in weak, medium, and strong cycles as they animated. We embedded the curves the animators crafted, and the system interpolated between them over time and strength. They could slide between no flapping to the strongest flap. The curve shape would change, and the dragon would move smoothly." The combination of flight cycles and tweaks gave each dragon its unique method of flight, whether hummingbird or bird of prey.

As with all the procedural and simulation systems created for the characters, whether dragon or human, the animators could tweak the performances. And because each dragon

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breathed fire differently, the riggers created controls within the rigging system for those performances, as well. The character effects team, though, created the CG fire—seven different types. The directors wanted each dragon to have different fire and wanted the fire to be different from any fire seen before in films.

"We looked at movies with live-action dragons and discovered that the fire tends to be the same propane gas explosion style," Ring says. "Propane gas makes great explosions on location without setting everything on fire. But, we didn't have that problem. So, we decided to make it more dangerous."

The effects crew primarily used Autodesk's Maya particles and fluids for base simulations, with Side Effects Software's Houdini breaking apart things the dragons exploded. They added color and detail via an in-house renderer.

Each dragon had its own set of effects artists working on its particular style of fire. "All the fire was independently developed," Ring says. "We shared some generic fire tools and volume rendering, but we had different artists hitting different targets, and it really paid off."

For example, inspired by high school chemistry class experiments in which students burned magnesium powder, Deadly Nadder's artists twisted Maya particles into sparkly fireworks. Similarly, particle-driven fire emitted from a hand-animated rock helped the Gronkle turn a rock into an exploding lava ball. Houdini helped break the flaming rock apart on impact.

A Maya fluid simulation, on the other hand, streamed gas from one of the Hideous Zippleback's heads. The same tool set with different parameters converted the gas into a fiery explosion when the second head lit it. And, Terrible Terror's giant blowtorch used both Maya fluids and particles.

Red Death's fire was perhaps the most onerous. "He has smoky, dirty fire, like an oil refinery," Ring says. "The fire is driven by a creature 500 feet long. At one point, he sets a whole fleet of ships on fire. So, the fire had to look big."

Coincidentally, a huge wildfire erupted near where some of the artists lived. "There were 50-foot flames," Ring says. "Some artists were evacuated out of their homes. It was on the news constantly." He and the other artists studied the fire to determine what made it look so big.

"It's about having pieces of flame breaking off, rather than having a continuous flame," Ring says, "and about lots of small detail. Our old volume renderer would have bogged down and crashed, so we rewrote it." The crew ran the base simulation for the huge fire in Maya, then added details on top.

Authoring in Stereo

This is the fifth film stereo supervisor Phil "Captain 3D" McNally has worked on and the second film at DreamWorks since CEO Jeffrey Katzenberg mandated that the studio would create all future films in stereo 3D. As a result, at DreamWorks, the minute a film moves from the storyboard stage, everyone is working in stereo 3D.

"We worked out what authoring in 3D is on *Monsters vs. Aliens*," McNally says. "We had to get the technical gear together—put the technical pipeline in place so we could author in 3D all the way from previs—train the artists, and so forth. So a lot of that work was in getting everyone up to speed and seeing that it was 100 percent successful in terms of delivering sophisticated 3D without hurting anyone."

Before work on *How to Train Your Dragon* began, McNally went back to *Monsters* and looked at what they had done. "I analyzed the settings we, as a group, had derived by sitting in the theater and deciding what we liked," he says. "Then, I came up with a little calculation that's now in our tools."

The calculation, which McNally dubbed the "Happy Ratio"—the tool even comes with a smiley face—gives artists a baseline from which to design the stereo. "Even if an artist hasn't worked in stereo before, we can get consistency," McNally says.

The way it works is that the tool has default settings for the volume of objects in a scene and the depth of a scene. "If we have a tennis ball floating within arm's reach, the ball needs volume because in real life we see around the sphere," McNally explains. "But a distant planet might be flat and far away in depth. So the Happy Ratio is a combination of these things."

McNally uses the way photographers manipulate camera apertures as an analogy for the way artists use the tool. "We have planes within a scene," he explains. "The artists decide which part is important. If it's a close-up, they'll set a marker on the nose of a character. The system knows the distance from the nose to the camera and guides the artist on the stereo numbers.

The tool also made it easier for McNally and head of layout, Gil Zimmerman, to make creative decisions as they designed the stereo experience.

"We would sit down at the beginning of a sequence and work out how the stereo should emotionally support the script," McNally says. "We had done this at the studio to some degree on *Monsters,* but this was the first time we could concentrate more on the emotional arc than the technology."

McNally offers an example, and here's the setup: It's a sequence where Hiccup has brought down the Night Fury. He goes into the forest to find out where the dragon crashed. Hiccup's capture device has netted the dragon, so Hiccup decides he'll kill the beast with his little dagger, take the heart back to his village and prove he's a knight.

"So as he's gearing up to do this," McNally says, "we ramp up the stereo intensity in sync with the camera push-in. It's not a stereo effect we think the audience will notice, but the intensity goes up further and further. One of the shots is a close-up of Hiccup with the forest behind, and he's standing with the raised dagger. At the beginning, the stereo is set at 50 percent of

modo 401® Dracula image by Rick Baker

normal. The character is a bit flat, the background is close. He's in our personal space a bit. As we ramp up, it isn't like the shot goes farther away or comes closer, it just expands. The volume within expands. It has the effect of the character getting closer and the background getting farther away. The audience feels the impact of the sequence, the music, lighting, and camera, but they don't pick out what we're doing in stereo. We think that's the perfect use of stereo: adding emotional intensity without drawing attention to the technique." When Hiccup decides he can't kill the dragon, the stereo drops down to be less deep than even in a normal sequence. The adrenaline drains from the scene.

In another sequence, Hiccup, who is riding on the back of the dragon, does a free fall along the z axis. "They do a rolling dive, like going off a roller coaster," Otto says, "and then they're finally flying."

The animators working on that sequence helped create the stereo 3D experience. "We want to make sure the 3D experience feels truthful and real," Otto says. "It's in the framing—the characters have to be within the frame—and in the timing. It's how long you play certain moments out, how you allow certain depth cues to happen."

In the free fall, for example, the animators hold back a moment as Hiccup is finally flying, to give the audience the same thrill Hiccup felt. But there are other ways in which stereo 3D has affected animation. "In 2D, everything is about silhouette," Otto says. "Stereo gives you more readability; it reads very differently. We're only scratching the surface."

McNally notes, for example, the action in animated films typically happens on a proscenium stage with the characters on the left and right, and the action playing across the frame. "In 3D, though, we no longer have the confusion of characters overlapping," he says. "3D can also carry more visual density. In 2D, simplicity works better, and we spent a lot of time in the past clearing the space and simplifying the shots. But, the more the better in 3D. We can keep putting stuff into the shots and it never gets confusing." *–Barbara Robertson*

At top, Ruffnut and Tuffnut face a Deadly Nadder. Note how the lighting in this shot and the lack of background detail focuses attention on the characters. At bottom, the gruff Viking trainer Gobber, who lost his limbs fighting dragons, stands out from the teenagers behind him.

Beard Taming

Although many Vikings in the film have various types of beards, Hiccup's father Stoick has the mother of all beards. "His beard is probably as complex as Shrek in his entirety," Otto points out.

Stoick's beard obscures his entire upper body and most of his face. "His face is the beard," Loofbourrow laughs. "His beard is his lips. His cheeks. Even his brows are hairy eyebrows. You have to look at the hair to understand his performance, to see the smile in his beard. We had to make sure his expressions showed through."

Riggers Doug Stanat and Sean Nolan handled Stoick's face and beard rigs, working together to shape his facial expressions and make sure he had follow-through on his dynamic beard. As in most hair systems, guide curves controlled the overall shape of the characters' hair and beards, with dynamics driven by the underlying performance creating the movement. Usually a character effects group runs the dynamics after the animators finish. Not this time. "In this case, because we knew the animators had to see the beard as they worked, we couldn't send the beard to simulation and back," Loofbourrow says. "It had to be part of the animation process. It wasn't fast. But, it was fast enough."

So that the animators could see the guide curves, the modelers turned them into tubes. "That gave the animators a low-res preview of the volume of the hair," says Ring. "We also tried to get as much movement built into the rig as we could so they could see the movement. We had the ability to mix hand-animation controls with physically-based dynamics."

Stoick's beard had 100 guide hairs draped over his chest and flowing along his face. The animators could look at the tube geometry and, using a magnet, pull the curves in a specific direction. "For really tricky cases, we'd take the guide curves back into Maya and use the whole suite of Maya tools—sometimes dynamic calculations, sometimes hand-animated keyframes—to get the hair-to-hair contact working right," Ring says.

A surfacing department added shader parameters that controlled the hairs' shininess, kinkiness, color, and so forth, and the studio's in-house renderer then multiplied the guide hairs into the thousands of beard hairs. The process wasn't always straightforward, though. "A whole bunch of departments are involved, and sometimes they worked in parallel," Ring says. "So you get to the end, look at it, and the animators move a guide curve, rigging adjusts the rigging, surfacing changes a shader parameter—iteration after iteration."

One reason for the iterations was that the crew created the film in stereo 3D. "This was one of the first films in which we looked at the hair and fur in stereo 3D," Loofbourrow says. "All kinds of stuff can happen in a bushy beard that you don't see until you put on 3D glasses." The problems typically happened with the guide hairs, with two guide hairs passing through each other—a problem exaggerated when the renderer interpolated the guide hairs into thousands.

"We previewed the beard in 3D as much as possible," Loofbourrow says. "We'd slap on the

little red-blue glasses. We couldn't see the beard in color, but we could see the problems."

Fifty people at DreamWorks worked on fire and water effects, and another 20 on cloth, hair, and fur. In addition, a lighting crew of approximately 50 artists brought the scenes to life using techniques from live-action filmmaking.

Light My Fire

"One of the things we hadn't done before was to bring in a live-action director of photography," says Ring. "This time we had Roger Deakins as a visual consultant. He came in once every month or two depending on his scheduling and sat in on color grading, too."

The eight-time Oscar nominee for best cinematography helped the team work interactively to develop the look. "In the past, we did paintings to guide lighting and provide inspiration," Ring says. "We did a lot less of that on this show and not at all for many sequences."

By using Maya, they could, just as Deakins might do on a live-action set, put a light outside a window or place a soft bounce card in a scene. "I think it really paid off for a style for the film," Ring says. "We had more contrast, richer blacks. We threw away detail to concentrate on the characters and pushed the live-action feel."

Animators could control the Vikings' hair and beards using rigs with built-in dynamic simulations.

How to Train Your Dragon has a look and feel that's as different from any of DreamWorks' previous films: *Madagascar, Kung Fu Panda, Shrek, Over the Hedge, Monsters vs. Aliens, Shark Tale, Flushed Away.* In part, that's due to Deakins' influence. In part to the design decision to set the caricatured shapes in a realistically textured world. But the result is a film unlike any other, and one—we expect the studio hopes—will lead to yet another successful franchise.

"What I love about this film beyond the visual design," Otto says, "is that we're in it for the long haul. From beginning to end, it's a deeply touching and charming experience. Of course, I'm close to it, but there's a sequence where there is zero dialog for six minutes and the story is told very clearly at that moment. I think the film really hits home in regard to heart, emotion, and charm. It's very truthful. That's what I like best about the film." ■

Barbara Robertson is an award-winning writer and a contributing editor for *Computer Graphics World.* She can be reached at BarbaraRR@comcast.net.

FOR GODS' SAKE

IT HAS BEEN LESS THAN 20 YEARS since the original *Clash of the Titans* stormed the box office to become the 11th highest grossing film of 1981. Legendary special effects artist Ray Harryhausen, who co-produced the film, created the stop-motion magic for that feature.

This year, three visual effects studios based in London wrangled creatures and composed environments to bring Warner Bros. Pictures' remake of the 1981 film to the screen. Directed by Louis Leterrier, the action-adventure fantasy stars Sam Worthington (Perseus), Ralph Fiennes (Hades), Liam Neeson (Zeus), and a host of CG creatures, including the Medusa, Harpies, witches, Pegasus, Scorpiochs, and the kraken.

The floor was originally a marble map of the earth, but to give the throne room at Olympus more drama, Framestore put the gods' feet in the clouds above a photoreal planet below with mountains, forests, and a moving sea.

Nick Davis was the overall visual effects supervisor. Framestore effects artists, supervised by Tim Webber, managed Medusa's multiple snakes, buzzed through Harpie sequences, and smoked the Hades effects in 444 shots. Simon Stanley-Clamp supervised a crew at Cinesite who wrestled a stinging, six-minute Scorpioch battle to the ground. The Moving Picture Company, piloted by Gary Brozenich, flew Pegasus, tackled the kraken, and splashed CG water in 220 shots, many of which are in the end battle. In addition, all the studios created environments.

Framestore: Medusa, Hades, Olympus

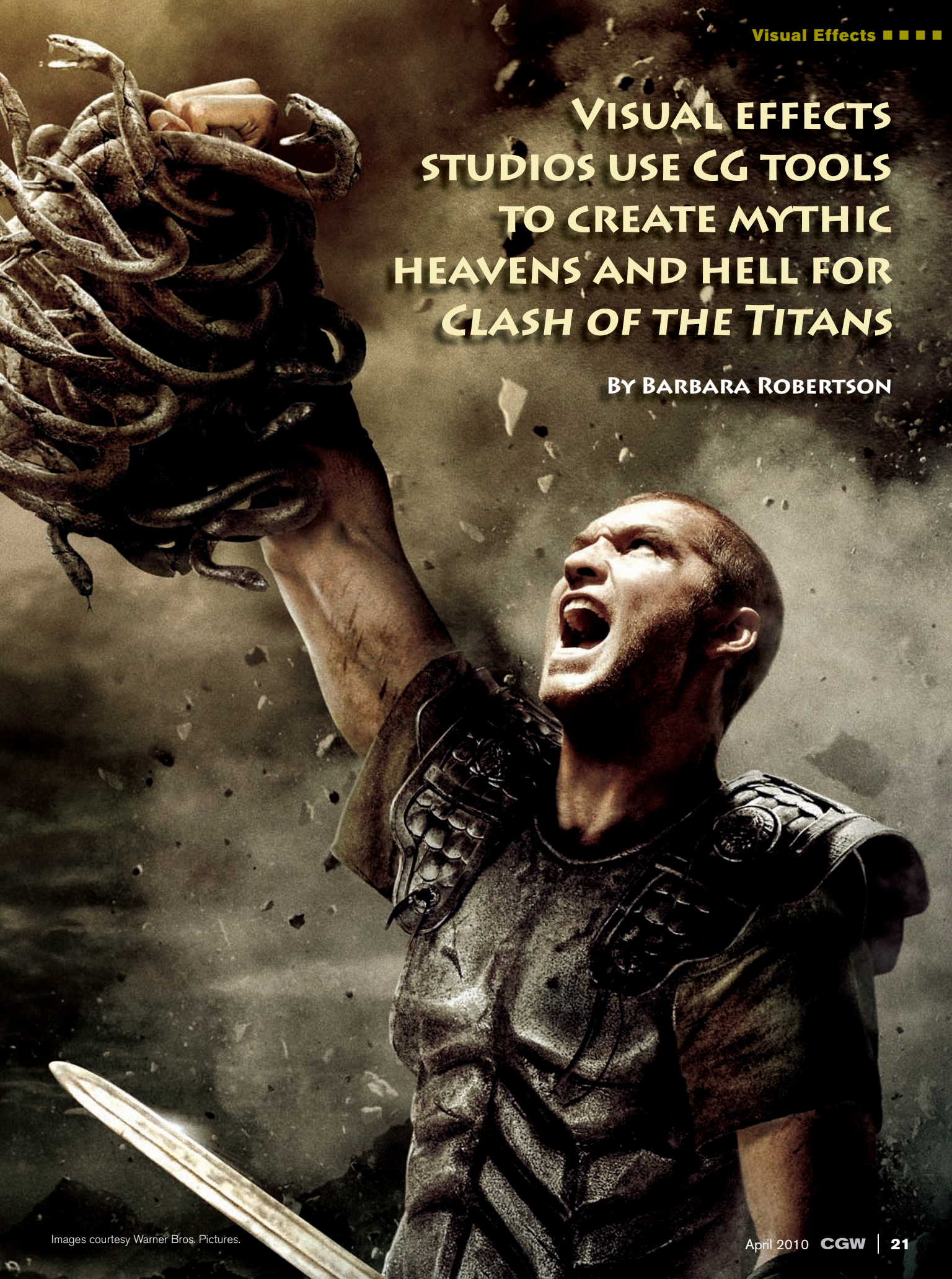
"Normally, we do two or three things—a creature or an environment—and lots of small effects," says Framestore's Webber. "But for this film, we did probably 20 quite different effects. The main ones were Medusa; Hades, played by Ralph Fiennes, who turns into smoky stuff; and the environments."

At first look, Medusa has a massive snake body, but her body slithers into a womanly shape, and her head has snakes for hair. For her face, Framestore used reference photos of the model Natalia Vodianova. "We had to try to make the snake body merge seamlessly into a human body and still feel snake-like," Webber says. "The 50-foot snake starts changing into a human body around the hips. You see a slight bulge, a hint of stomach muscle, and the scales smooth out. She has metal armor—a kind of metal bra with a snake design."

Other than snakes in her hair, the mermaid-like Medusa looks human from the upper half, but her lower body is a scaly snake, not a fish. Each individually modeled scale moved with procedural animation as her skin moved. "We wrote an in-house plug-in for [Autodesk's] Maya to man-

Visual effects studios use CG tools to create mythic heavens and hell for *Clash of the Titans*

By Barbara Robertson



Images courtesy Warner Bros. Pictures.

Medusa's head transforms from a snake to a beautiful woman with snaky hair, and back again. Animators at Framestore controlled the timing of the morph and the individual snakes.

age the scales," Webber says. "She was quite a technical challenge. She doesn't have any dialog, but we needed to give her facial expressions based on Vodianova, so we had a full-on facial animation rig."

When Medusa petrifies people, her head changes from a beautiful woman to a scary snake. "We had two models in 3D, both animatable," Webber says. "They had to morph one to the other, so the model could change, the textures could change, and the skin surface parameters could change. They didn't all change at the same time." Hints of the snaky face remained, for example, when she morphed back to a human. Animators controlled the timing for the morph and for the snakes.

"We considered procedural techniques for the snakes, but ended up doing a lot of hand animation," Webber says. "They had very individual behavior."

Hades, too, sometimes looks human and other times a dark essence. He first appears as long streams that flow through a crowd and join together to form a spout of black vapor with fire inside. The spout becomes a tornado that sucks soldiers inside and then spins into Hades in his human—Ralph Fiennes—form wearing a cloak. The cloak's edges are on fire.

For the dark essence, Framestore effects artists used Maya and Side Effects' Houdini, plus volumetric rendering. "It worked differently in different shots," Webber says. "We had thin tendrils, a giant column of smoke, tiny wisps, a big spout like a fountain, so we used Maya fluids, but mostly Houdini. For the spout, we used different types of fluid solves and then ran particles through it."

Twice during the film, Hades and the Harpies morph into each other. The first time, the Harpies attack soldiers and then fly together into a spinning ball. The spinning ball becomes the dark essence that, as it slows down, turns into Hades' cape. The cape opens, and we see Ralph Fiennes, who was a bluescreen element. Animators manipulated the black Harpies into the spinning ball; particle simulations turned the ball into smoke.

The second transition starts with Hades. When he flicks his cape forward, the cape breaks apart and each part becomes a Harpy. To make this possible, modelers built the cape with separate panels. Animators moved the parts away from Hades, and then effects artists ran a cloth simulation that responded to the animation. A 2D morph turned the pieces of cape into Harpies.

In addition to the creatures, Framestore also created several environments—the witches' mountain, set extensions for Medusa that included caverns with boiling lava and a temple on a hillside, the misty landscape around the River Styx, but the most notable and biggest environment is Olympus. "In the opening shots of the movie, we have a massive fly-through of Olympus," Webber points out. "We come down through a huge dome filled with tiny statues of humans, fly over a map on the floor and out through a corridor, and then up into the clouds. We based one establishing shot of the exterior on a helicopter plate taken from up in the clouds. Another was completely CG—the clouds, the waterfalls, the mountain, the plants."

For environments, Framestore typically creates geometry and projects textures in Maya using procedural-generation techniques for natural landscapes. "We also did matte paintings and used basic projections in [The Foundry's] Nuke, and built fully CG stuff with textures, lights, shaders, all completely CG," Webber says. For rendering, the team used Pixar's RenderMan and, for the fly-through of the interior, Mental Images' Mental Ray.

Knowing that shots would take place in the interior, Framestore was prepared to build set extensions for the throne room and the corridor leading there. On set, the floor had a marble map of the earth to illustrate the gods' power over the planet. But later, this didn't seem otherworldly enough. "We replaced it with something much bigger," Webber says, "a photoreal earth with a moving sea, mountains, forests, and floating clouds. The gods walked through the atmosphere. They had clouds at their ankles."

After some concern that audiences might wonder whether the gods would tread on villages as they walked, the artists decided to make the scene less real. "We made it very cloudy to distract people from worrying about those issues," Webber explains. "The whole place became a glowing atmospheric place with swirling clouds. We enhanced the gods'

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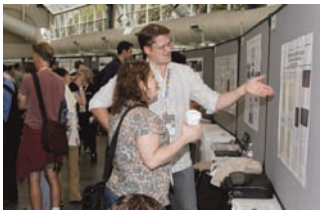

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costumes as well, to give them magical glows." The effects artists swirled the clouds with fluid solvers and created the shapes using RenderMan shaders. Compositors placed the gods in the mist using The Foundry's Nuke.

Of all the work, Webber is especially pleased with how the crew treated Medusa. "She was a completely CG character," he says, "a fascinating mythical character with human expressions. Not many films have done photoreal human faces in close-ups, and I think she looks incredibly real even though obviously she's not. We're proud of that."

Cinesite: Scorpiochs

The giant CG scorpions come in 15-, 30-, 40-, and 65-foot sizes and battle the warriors for close to six minutes. When tamed, they become methods of transport across the desert, following one another nose-to-tail like elephants, with as many as six people at a time riding atop in a palanquin.

For reference, the Cinesite crew filmed four different scorpion species at a scorpion farm and brought two large creatures back to the studio for closer study. "The bigger they are, the less venomous," Stanley-Clamp says. "We watched how they jumped, how fast they could run, how far they could reach. We got them to run around and follow things. We also saw reference online of amazing fights between scorpions and rats."

Modelers created the cinematic versions in Autodesk's Mudbox, and riggers worked in Maya. "The scorpions have eight legs, so they aren't the typical quadruped, but we've done spiders before," Stanley-Clamp says. "The main consideration was the palanquin." The riggers constrained the creature's tail so it couldn't push through the palanquin, and attached reins from the riders inside to the Scorpioch's mouth and claws.

Leterrier planned to film the battle between the giant stinging creatures and the soldiers in three areas of Teide National Park (Tenerife, the Canary Islands), so set builders arrived a month early to add broken architecture to the natural environment. That gave Stanley-Clamp and a crew the opportunity to survey the set before the shoot. "We went out a week before filming and did a survey and reference photos," he says. "We had measurements and a Lidar scan taken the weekend before filming, and we did rudimentary photogrammetry. I also did HDRI photography every hour on the hour for that week."

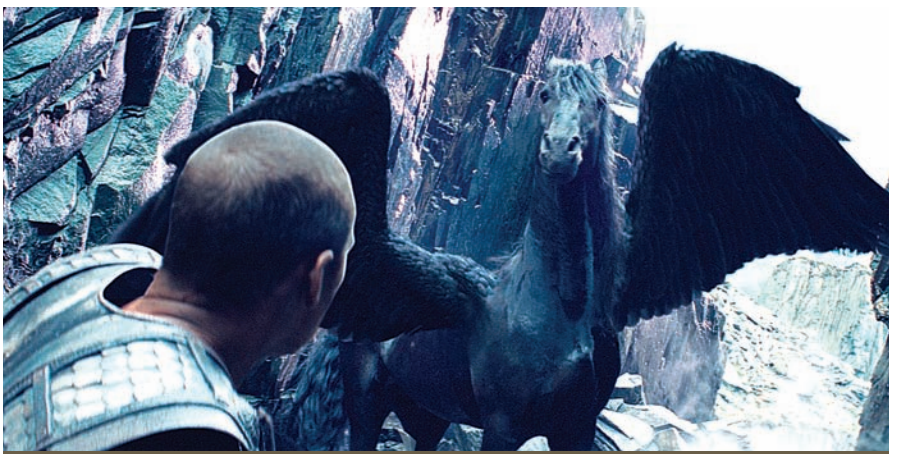
In addition, Stanley-Clamp took shot-specific HDRI photographs during filming, but because the action took place in daylight and the sky was rarely cloudy, the early work paid off.

As the crew filmed the action, Sam Worthington (Perseus) fought, in close-contact scenes, with a green-suited stuntman on a pogo stick holding a big block. Using in-house software, Cinesite gave the director a real-time overlay of the CG scorpion onto the live-action footage during principal photography.

For the travel montage, Cinesite inserted the palanquin-carrying scorpions into footage shot in the Canary Islands, Ethiopia, and Wales, adding digital doubles for wide shots and to send people flying through the air if flung off the tail of a scorpion.

As the giant beasts trod along, Cinesite kicked up dust and dirt using Houdini. "We rendered the dust as conventional passes and moved it into Shake with as much depth cuing as we could get," Stanley-Clamp says. Although the studio's core compositing tool is Apple's Shake, compositors also used Nuke on some difficult and dynamic shots. For tracking, they used primarily Science D Vision's 3D-Equalizer.

Stanley-Clamp credits the crew's ability to push through their shots so quickly in part to his ability to go on location early. "We had three months," he says. "We had to hit the ground running, and everything went to the wire. So we definitely reaped the benefits of getting out to location early—almost to the point where we'd pay to go out there ourselves. The crew doesn't like visual effects on set because we slow them down. They don't want to get out of the way so you can do a survey. So the time invested upfront pays for itself in the long run."

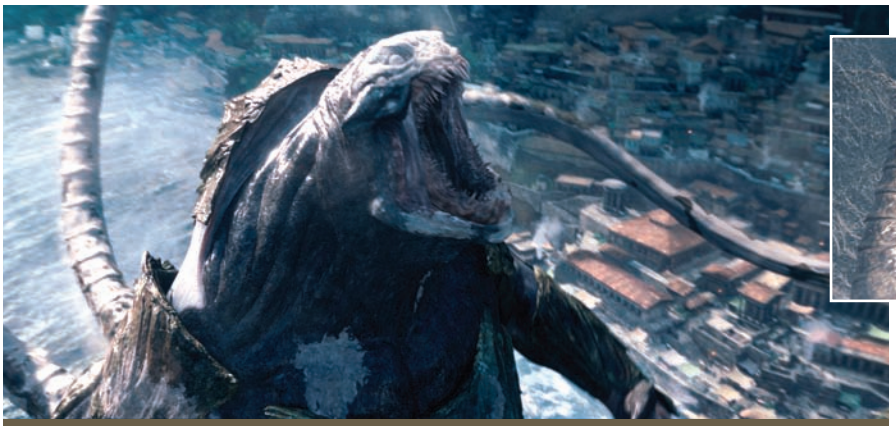


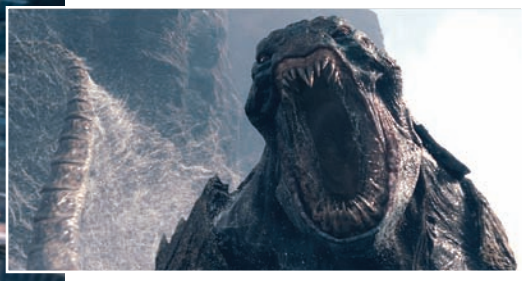
(At top) Aaron Sims, character designer for the film, developed the Harpies' design; animators at The Moving Picture Company gave the winged creatures their personalities. (Bottom) For Pegasus, MPC artists put CG wings on a real horse and created a digital double.

MPC: Pegasus, Kraken, Argos

Although VFX supervisor Gary Brozenich began working on the film 14 months before release, from the time principal photography ended and production started, the crew had five months to deliver their 220 shots. "We did a number of different things through the film—CG water and ocean, everything that was Pegasus-related, the CG Argos environment, the kraken, and the Harpies, so the end sequence was our main work."

For Pegasus, The Moving Picture Company added CG wings to footage of a horse shot on location. "Whenever he's running on





The CG kraken smashes into a digital breakwater as digital water streams down 700 feet of its giant body, and then the monster demolishes CG buildings in the city with its thrashing tentacles. MPC's rigid-body dynamics solver managed the destruction in these all-CG shots, which took months of development.

the ground, we tracked and roto-animated the shoulder area to tightly attach the wings," Brozenich explains. "We had to replace the upper shoulder to seamlessly blend CG skin, hair, and flesh to horsehair and flesh."

Because the horse could cover hundreds of yards in a short amount of time, MPC used an elaborate marker system and positioned witness cameras along the route. "We captured the horse from these static cameras to track it in 3D space from multiple locations," says Brozenich. "We also had Lidar scans of set pieces."

Rather than a horse that magically flew like a bird, Pegasus would build momentum on the ground and glide up in the air. Once in the air, the horse became a digital double, fully CG, performed by animators.

The enormous kraken, on the other hand, was always fully CG. It has crab-like claw legs, a human-like torso, a reptilian head, a long tail that ends in a series of smaller tentacles, and more tentacles growing out of its back. It is armor-plated. When it rises from the water, the part that is above water is 700 feet tall.

"Rigging was quite an effort," Brozenich says. "We built into the rig a lot of what we would usually do in techanim [technical animation]. The tentacles used an FK solution because that was the cleanest rig for the animators, but they also went through a secondary pass to add wiggle and jiggle."

To help the animators have something that large move through the city of Argos, the team attached a speedometer to the character and the camera. "The trick was to have his perceived speed move relative to the camera move," Brozenich says. "We tried to make something that could never possibly be real seem real."

When he rises from the water, particle simulations in Scanline's Flowline and in Maya stream water from the surface. During one 40-second shot of the creature's full body coming out of the water, the compositors layered 60 particle-cache renders. When the creature's tentacles smash into buildings, MPC's PAPI, a rigid-body dynamics solver, destroyed the structures. Because PAPI works with the studio's Alice crowd-simulation software, they were even able to throw digital people into the mix. "We used a combination of PAPI, Flowline, Maya, Maya plug-ins, plus shaders for the water," Brozenich says. "It took months of development. But, this was the first time we were able to render Flowline through RenderMan, which was a huge advantage. We could use the same HDRIs and reflection maps, and the TDs could run everything through one lighting pipeline."

The kraken battle takes place in Argos, which was partially a set piece, but largely CG. "We had one long road, a central square, and four smaller roads off that on set," Brozenich describes. "We also had a set for a lighthouse. The rest of Argos was computer-generated."

The city is in a canyon surrounded by cliffs, a sort of arena that extends to a large harbor—the harbor from which the kraken emerges. The crew based the cliffs on those in Tenerife, but rather than the existing landscape, the artists carved a digital gorge, used photos of the cliffs as reference, built an ancient city into the cliff sides, and added a horseshoe-shaped inlet.

"We photographed Malta locations to get architectural types and [locales in] Matera, Italy, to see how structures would be derived and built into cliff sides, then presented storyboards to Louis Leterrier and Nick Davis," Brozenich says. "Once they approved the storyboards, we shot individual buildings for photogrammetry." The crew shot buildings in Malta, Matera, Edinburgh and Glasgow (Scotland), and Bath and Oxford (England)—any city with neo-classical structures—and then used the textures to create new buildings in Argos.

"This is a new Greek city, so we needed new buildings, not ruins," Brozenich says. "The neo-classical buildings were in better shape than the old Greek buildings."

To manage the huge city, the layout team divided it into sections using London's postal codes to identify areas in particular shots. "When we're looking from the kraken's head view, we see a third of the city, so we loaded that portion," Brozenich says. "We had tens of thousands of pieces of geometry: props, trees—32,000 trees—and God knows how many canopies, market stalls, streets. And then on top of that are the crowds that we drove through Alice."

MPC has created cities and crowds before, but this time the studio took a different approach. "We always knew we'd have CG shots with CG characters," Brozenich says, "the kraken, Perseus, Pegasus, crowds, the Harpies. We wanted to make the city like any other asset, so we lit, rendered, and treated it through the same pipeline as the creatures. That added complexity to the way we rendered shots, but it was part of the normal lighting process. So, we didn't need to have separate teams on the city. Any TD could pick up and light the city just as he or she would light a character."

Whether or not these shots push the state of the art of visual effects in general, Brozenich feels the film pushed the state of the art at MPC. "We never expected to be in a position to do a 40-second, full-CG city with an 800-foot creature emerging from a CG ocean. So, in terms of the types of shots we are able to handle, it definitely pushed us. And, from a storytelling point of view, it was a great time."

It's amazing that these studios created most of the effects in less than six months. If anyone wants a good touchstone for how far digital effects have matured in less than 20 years, comparing this remake of *Clash of the Titans* to the 1981 version would be a good place to start.

Barbara Robertson is an award-winning writer and a contributing editor for *Computer Graphics World*. She can be reached at BarbaraRR@comcast.net.

Lab Report

A look inside Autodesk Labs, where technologies are put through their paces

By Karen Moltenbrey

What is Autodesk Labs? It is a group within Autodesk that is home to innovative, new technologies and collaborative development. Started approximately three years ago, Labs explores technology that may be commercially relevant to customers in design—from architecture and manufacturing to film and games. The goal of Labs is to take invented technologies and integrate them into early, experimental prototypes that the Autodesk Labs community can try out, with the goal of determining whether the technology could be made into a product or a function within an existing product. Basically, they strive to engage the design community to determine whether a certain technology has value.

Recently, Brian Mathews, vice president of Autodesk Labs, sat down with *CGW* chief editor Karen Moltenbrey to discuss what this group does and the effects of that work on designers around the world.

Brian Mathews

When was Labs formed?

There were a few different incarnations of it, but the current format started about three and a half years ago.

How many people work in Labs?

Approximately 30, but that's misleading since my core team coordinates projects that leverage technology experts anywhere in the company. The virtual team is much larger and dynamically changes based on project needs, with people rotating in and out continually.

Where is Labs located?

Because of its dynamic nature, this question is hard to answer. If we just consider the core team, I'd say we are headquartered in San Francisco, with staff in Chicago, Phoenix, San Rafael, France, and China.

How are the groups within Labs formed?

Some projects, like Project Showroom, are created in four different locations. The project has a lot of specialty areas in it, like high-performance computing experts (people who know how to run clusters with thousands of cores), content schema experts, computer graphics global illumination experts, material science experts, Web design experts, data center experts, and so forth. So a project like Showroom spreads into several different areas and different teams globally.

What is the group's goal?

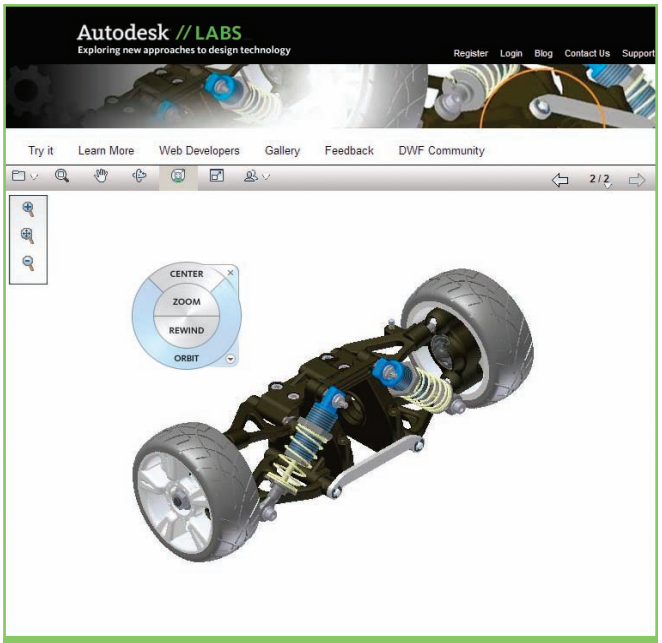
Our primary goal is to engage a community of early adopters in the development of new design technologies. Everyone in the company has a role in innovation. Labs' role is to sit in between our research teams and our product teams to develop inventions into innovations: We mature horizontal technologies to prove they are ready for commercialization by product teams.

Take multi-touch, for instance. Four years ago, before the iPhone shipped or Windows 7 had multi-touch, Autodesk Labs did a bunch of "maturing" development in this area. From an invention point of view, multi-touch had been around since the 1970s, when universities were working on it. Several Autodesk researchers had in fact been working with multi-touch for decades. But, obviously, multi-touch hadn't become a practical innovation. That is where Labs came in: We took something possible and attacked some of the technological and business barriers to making it practical. We created several prototype products and engaged our community of customers to gather feedback. We are successful in maturing a technology when we are able to graduate a technology out of Labs and have a product team pick it up.

What does Labs do, then?

The mission of Labs is to explore and validate new approaches to design technology through functional prototypes. Our vision, as I mentioned, is to engage a community of early-adopter customers in the development process. We have a lot of R&D that happens directly in Labs, but we also take emerging technology from other parts of the company and connect it to our early-adopter user community.

In a traditional product development process, new technology is kept secret until it hits beta. In that process, customers are only involved at the very end, where all you can do is fix bugs. In contrast, the Labs process is to take technology and involve customers in development from the very beginning. For example, we've taken emerging concepts like cloud rendering and built Project Showroom, or 3D software as a service (SaaS) and built Project Freewheel (for viewing and sharing designs over the Web), or application remoting and built Project Twitch (running application trials over the Web). Each of those examples started out as a tangible prototype that evolved with customer feedback. Look at Freewheel: We took the idea of allowing people to collaborate using a SaaS model; early adopters—people who want a competitive advantage through technology—helped us grow it into a Web service that gets hundreds of thousands of hits per year. These users want to know what is coming down the line so they can shape it, form it, even before it may be practical.



Based on SaaS, Autodesk's Project Freewheel combines a dedicated Web site and a Web service for interactively viewing design data.

Where do you find these early adopters?

Mainly through our Web site. We have a community site (http://labs.autodesk.com). We do a daily blog, and that gets a lot of traffic. We also have e-mails and newsletters. People in the know and who follow technology and Autodesk—the early adopters—find us. We also do various trade shows, like Autodesk University.

How do you decide what to look at?

My analogy is that I am the museum curator; I don't make the art, but I choose what gets shown. There are others who create technology that may be too risky that's not ready for prime time, or hasn't been productized into a tangible prototype. Some stuff just doesn't make the cut—it's not thought provoking or doesn't really need an early-adopter community to perfect it. Many of those technologies are handled by a product team. I try to keep most little utilities or productivity tools out of Labs. There are other avenues for those things.

What do you look for in a technology?

We are looking for horizontal tools and technologies that would make designers in any discipline more productive.

Are you concerned about competitors stealing your ideas?

That comes with being open, but it goes both ways. We're dealing with immature technologies where others may copy us both in what works and what doesn't work. We can be a catalyst that gets the entire industry involved in finding answers. By being open, we're able to solicit a tremendous amount of user feedback that helps us shape the

product. At the end of the day, our main goal is to make a tool that works for our customers. If we make something valuable for them, how can you really lose with that?

How do you deem a technology good enough to graduate out of Labs?

Each technology is different. Once Labs has gotten rid of some of the technology speed bumps, and when our engineers say the technology has legs, and when our customers show interest, then product teams often say, 'Hey, I want to own that.' That's when we graduate it and hand it off. Some technologies never make it and are killed either because the prototype didn't work as desired, or customers were disinterested. Failures are part of the process: By getting user feedback early, we can free up engineering resources for new projects that show more promise.

Our users also pitch ideas. They usually want a new feature in a product they already have. It's rare that they come up with a brand-new invention of how to apply technology. Our customers usually innovate in their own fields, like bridge building or airplane manufacturing, so they bring deep domain expertise that augments the software development skills we have. The advantage of a large community is that there are always people who know more than you about something.

How long does it take to graduate a product from Labs?

We've only been around for three and a half years, but if you go to the Labs Web site, there are dozens of technologies that have been built over that period, and there is a page that shows all the technologies that have graduated from Labs. A lot of the time these technologies become a feature in existing products. Some of the translators and analysis tools have shown up in Inventor, Revit, and AutoCAD. Some have become their own product, like Inventor LT. Still others we have walked away from for a number of reasons. For instance, three years ago the picture-based visual product search concept was interesting but the technology wasn't ready, and we withdrew it from the site.

What are some of the technologies with great potential?

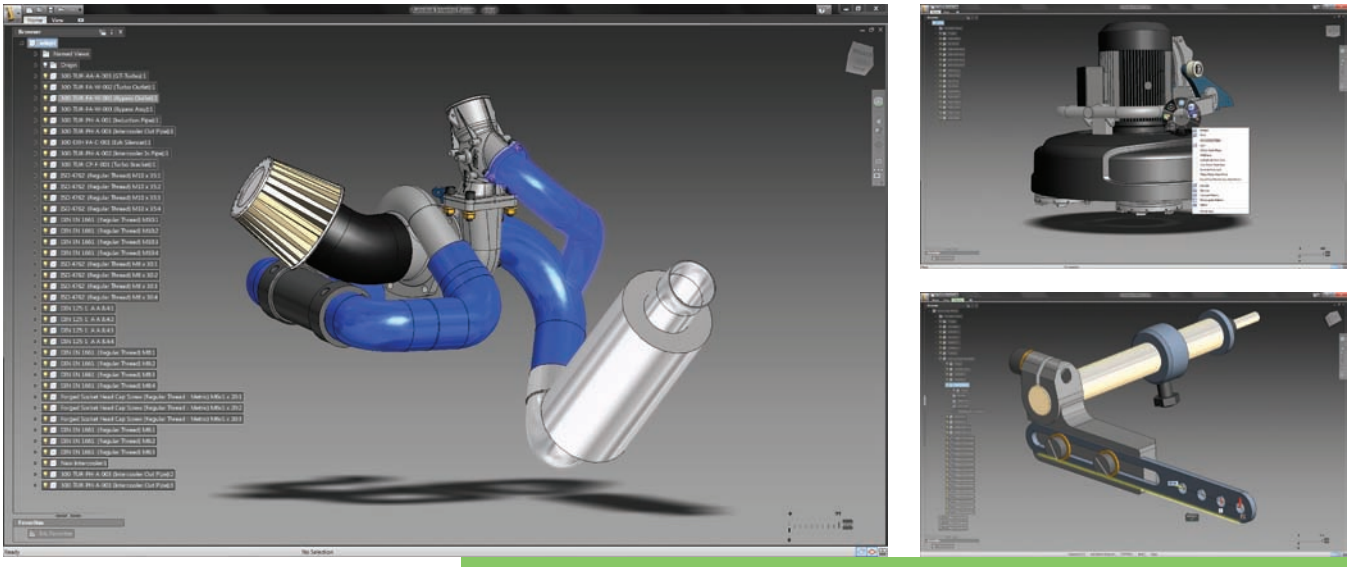
Inventor Fusion, which is the idea of re-envisioning what Inventor looks like if you do history-free modeling. You have direct manipulation. You can grab your model, like a hole, and drag it and make it bigger without having to go into the parametric recipe. It is a lot simpler and has a much easier learning curve. Unlike other history-free modeling systems, with this one you get the best of both worlds since it automatically synchronizes a parametric recipe, which is technologically complicated. Many people said it was impossible or very, very difficult. It's currently not production-perfect, but amazingly close, and that's why it is in Labs.

Another technology was launched at this past AU, Inventor Publisher. This is a standalone technology preview. We have Inventor (for doing product design) and Design Review (that allows people to review, mark up, and play assembly animations of what the product looks like), but customers told us they still needed an easy-to-use tool that helps them create clear and comprehensive technical instructions. A CAD group can design the chair you are sitting in, but the technical publications department makes assembly instructions. Now with Inventor Publisher, a manufacturer can take the CAD model and augment it with other information and help publish the data in an interactive way to its customers on the Web or even an iPhone.

What about Twitch?

That is one project we have been working on for years. We saw the promise a long time ago when we did Project Freewheel. When you look at SaaS applications like Google Mail or others, they are a compromise when compared to their desktop equivalents. You can't really do 3D graphics on the Web with current standards. So we thought about how far we could push 3D over the Web. Freewheel was a zero client; you didn't have to install anything because it was purely HTML. We were able to do 10 frames per second of full-screen graphics on entire cities because we would render on the server; in doing so, we did some tricks with JPEGs and sent them down to a browser or smart phone, where we found we could do some simplified 3D over the Web. We then started doing complex user interfaces. When we saw what we could do, we thought, What would CAD look like on the Web? You would want perfect fidelity, zero latency, and high performance. Project Twitch came out of that. We investigated a lot of technologies in this space that just fell a bit short. So while we had the concept for a long time, it is only recently that the technology is ready.

Think of Twitch as a 1000-mile-long VGA



While the goal of Autodesk Labs is to graduate a technology, not every one of them finds its way into a product. Above are images from Inventor Fusion, a history-free modeling concept.

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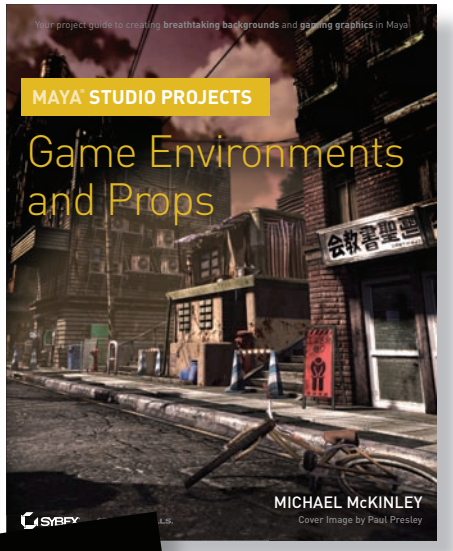

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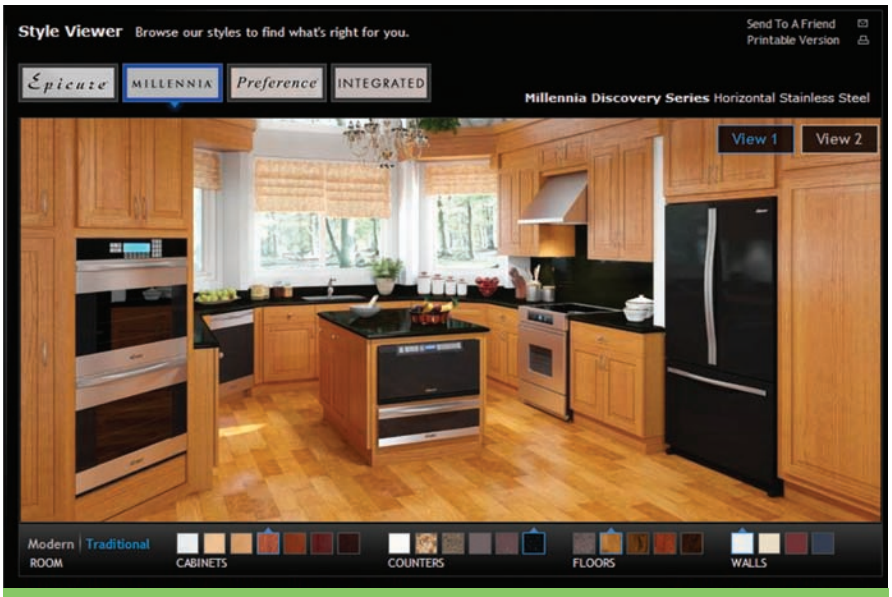
cable. We replaced that cable with an Ethernet cable. People tried to do this before, but their solutions required tons of bandwidth, or they degraded image quality, or they buffered, which introduces latency. While many videoconferencing systems work just fine, those technologies don't have the resolution and low-latency qualities you need to remotely run a CAD application over the Web. We need latencies that are sub-50 msec. The best standard compression technologies out there have about 250 msec and can eat up 10Mb of bandwidth for HD video. Twitch can go as low as 3Mb, with latencies as low as 10 msec. So with Twitch, we have all the benefits of a SaaS application—easy to implement, no capital expenditure, collaboration, real-time data access, data centralization—with all the benefits of desktop software because we are running desktop software.

Oh, and it runs better than your current desktop software because we have super-tricked-out hardware in a data center that is dedicated to you when you're awake, but the price is lower since we re-use that system while you're asleep. Before, if someone in New York and London wanted to collaborate, they constantly had to move their files and versions around. But if you can just move the video around, you can leave the data in the data center, and you have instant access to it over fibre channel. This is the first no-compromise SaaS solution—benefits of the desktop with all of the power of the Web.

How does SaaS come into play?

SaaS is not just about doing stuff faster. You can now take a 1000-CPU-hour computation and run it on one machine for 1000 hours and it costs the same as if you ran it on 1000 computers for one hour. In the past, that was not the case. You can now rent supercomputers in the cloud by the second, giving you access to compute power you never had before. One example of this is Showroom. Imagine laying out a kitchen floor plan and getting a physically accurate photorealistic rendering in four seconds. Normally that would take four CPU hours, but with 2000 cores, you can squeeze that into four seconds. The Project Showroom concept is about letting you do really high-quality rendering in near real time by using thousands of cores. Technically, writing software for that is different than how you write desktop software.

At Labs, I look at our recently acquired analysis, simulation, and visualization technologies, and consider how to adapt all those engines into a supercomputer in the cloud. If you want to design a green building or a sustainable building, someday we'll do real-time simulation *while* you are designing. Currently, people design the building, send it out to an analysis firm; a few weeks later the results are sent back, and it either meets code or fails, in which case you have to redesign it. If we can have the analysis happening in the background while you are designing so every couple of seconds you get a result back, you will design a better building.



Project Showroom lets users mix and match product selections, textures, and colors from leading manufacturers using a Web browser.

What allowed all this innovation to occur?

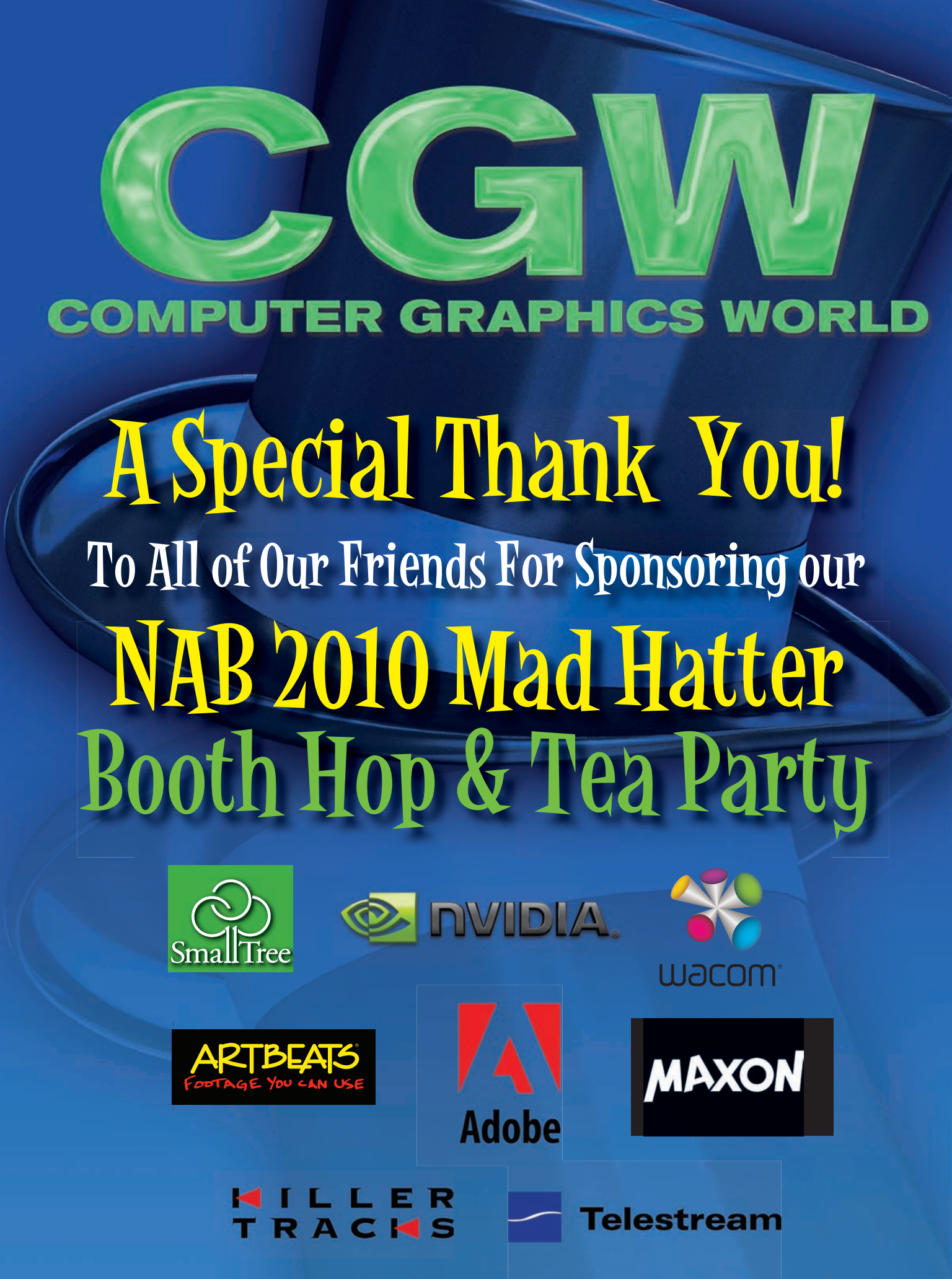
A combination of many things. Like any innovation, it is evolution on a path. You have to have the Internet, search engines, content that is in a searchable universal format, rendering, and simulation technology. All this information has to be written in such a way that it can be done in parallel over multiple cores rather than just faster single cores, an operating system that can manage a large number of cores, and network implications. Most Web applications use redundant components, and it is very expensive. That is how most Web hardware is built—expensive and reliable. That's great for normal Web apps. But when you get into cloud computation, you no longer want to use the same approach; you want the software to be fault tolerant, not the hardware. In this way, you can buy much cheaper hardware. That is another innovation—you get the price down, and then you need a business model. Most people cannot run their own big supercomputer centers, and that is where Microsoft Azure and Amazon EC2 come in—they offer computers that are rentable on-demand and priced by the minute.

These services are all focused at the small players right now. Bigger companies generally run their own data centers at some scale, but they have to have the machines. The equipment has to cover their peak usage, and they have to buy enough for that one hour a year, for the worst-case scenario. The rest of the year it goes unused. Now with cloud computing, the bigger companies can right-size the big data centers so they can buy based on the average, and when the need arises, they can make an API call and burst the application into EC2, for example. It makes for a more efficient data center and drives the cost of computing down dramatically—and that drives innovation.

Moore's Law has computing power doubling every 18 months. Now we are seeing Moore's Law to the third dimension with cloud computing. Moore's Law has always been two dimensional—two dimensions on a chip, a two-dimensional surface. In a data center, you can stack computers into the third dimension and you get a different Moore's Law through Web access. So the cost of computing is going down, and that has implications across all our lives—entertainment, medical, and so forth.

Is this invention or innovation?

What really counts is innovation, not just invention. Invention is great, but until you innovate about how to use it and solve a real-world problem with a real-world delivery platform, invention is only intellectually interesting for us geeks. But innovation is where the productivity gains come from. It is how you bring sometimes-old ideas together to solve real-world problems, and you've got to involve the customer in the process.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BRICK BY BRICK

By Karen Moltenbrey

An architect uses digital tools to design a house made entirely of LEGOs

When Barnaby Gunning was a youngster, he, like so many children, played with LEGOs, using the small, colorful, plastic bricks to build a multitude of objects. Who would have imagined that, many years later, he would be playing with LEGOs once again, only this time using millions of them to construct a life-size, multi-room house—including a kitchen, bath, living room, and bedroom, complete with fixtures and furniture, and all made with none other than LEGOs.

Gunning, a principal at Barnaby Gunning Architects in the UK, designed and helped build the LEGO house for the BBC television series *James May's Toy Stories*, in which ambitious projects are created using popular toys. The project, however, was far from child's play, requiring a great deal of digital design work and planning before construction on the unique structure could begin.

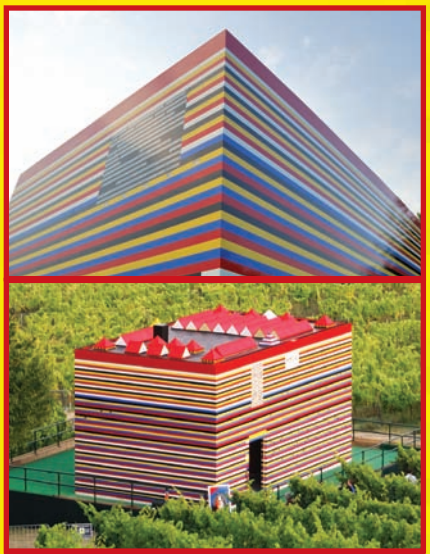
Always up for an adventurous project, Gunning received a call several months ago from a former colleague who told him about the TV crew's plans. "As architects, we are interested in systems and how you can construct buildings," Gunning says of his firm. He spoke to the series' producers and was surprised when, a few months later, he received a phone call asking him to join the effort.

As if building a house from LEGOs wasn't challenging enough, the project was hampered even more so due to the broadcast. "It's one thing to build a house in which the time scale is sort of determined by deliverables, but with a TV show, the whole thing has to be juggled around their [filming] schedule," Gunning says. From early discussion to air-date was just three months—not even enough time to construct a regular house. This home, however, was far from "regular."

Because the clock was already ticking for the TV producers, they had ordered the LEGOs for the project before Gunning signed on—approximately three million of them, which equated to a week of production at the factory. "They ordered the standard LEGO bricks online," says Gunning, "350,000 of this one, 250,000 of that one…." To determine the amounts, the crew built a toy-scale house (about a foot long and five to six inches high), and calculated the number of bricks that would be needed if that model were scaled to full size.

As to not influence Gunning's design, the small model—a single-story house with a roof and terrace—was not shown to the architect and his firm. Moreover, when the designer met with the TV presenter, James May, he was pleasantly surprised that the host did not dictate specifics of what he wanted in the building, but rather left it up to Gunning. "He wanted us to build a house made of LEGOs, not just make a model of a house," adds Gunning. "Oftentimes LEGOs are used to build a representation of something else. So the obvious thing would have been for him to say, 'Here is a house I like, make it out of LEGOs please.'" He did not do that, much to Gunning's delight.

May's hands-off approach was ideal for a number of reasons. "LEGOs are a construction toy, and you can't just scale up something," says Gunning. "And when you start making something at full scale, the nature of the full-scale [object] will be determined by the building material, in this case LEGOs. We needed to find out what we could do and not do with LEGOs, and then determine how to put three million bricks together in less than three months' time."



(Left) Architect Barnaby Gunning used Luxology's Modo to plan the LEGO house; (above) the completed structure at the building site.

Design Concepts

When Plum Pictures, the series' production company, had approached Gunning, the LEGOs had not yet arrived. To get an idea of what he would be dealing with and to design the unusual structure, the architect made a virtual LEGO set within Modo, Luxology's 3D modeling and sculpting software. "I always use computer modeling as a way to test out ideas," says Gunning, whose previous projects include the British Museum Great Court, The Esplanade Theatre Shells in Singapore, and numerous private houses in the UK. "I am of the generation of architects who

Well over three million LEGO bricks were used to build the full-scale house. Some pieces, such as the people figures (top, left), were donated by the public. Other pieces were used for constructing the exterior and interior (top right).

started using 3D modeling to show ideas."

Throughout his career, Gunning had tried various software programs prior to standardizing on Modo in 2004. "I was excited because finally there was a 21st century 3D modeling program that didn't have all this bloated code floating around in the background," Gunning says. "I can fly around, play with the design, change bits and pieces, and the results are immediate."

For this project, as he does for all his architectural endeavors, Gunning drew concepts by hand and modeled them in Modo, moving back and forth between the drawings and the 3D model. "My current dissatisfaction is in the lack of tight linkage between Modo and the drafting program we use, [Nemetschek's] Vectorworks. The program is okay, but I feel like I am using systems from two different millennia and not getting the most out of it," he says.

For the LEGO house, Gunning used Modo to not only get a feel for the design, but to communicate the concepts easily and efficiently. Usually that is in the form of presentations to clients, but in this scenario, the use was twofold: to generate an overall design and explore the layout of the house, and to convey the unique instructions for assembling the LEGO bricks into blocks, or components. Both required the ability to quickly duplicate instances of geometry, and to accomplish that, Gunning's group wrote a number of Python scripts to generate the larger bits and pieces of the house.

For instance, "creating instructions for building the roof pyramids could have been time consuming, but instead we were able to write a simple script that created the roof pyramids quickly from our virtual LEGO set," Gunning explains. "It can get confusing counting bricks on something like that because on each course there is a different amount of bricks, and you just can't say, 'I am adding two bricks here each time.' You need to know which types of bricks you are adding each time you do so. Knowing what the logic of the structure was, I could generate the whole of the pyramid, and at the same time, the script could tell me how many and what types of bricks were in it."

Gunning also used Modo to create basic components for the house, each containing several hundred LEGO pieces. In essence, the LEGO house would comprise thousands of smaller "houses," some with windows, some serving as roof pyramids, and some as hollow blocks that would be used for the structural beams. With Modo, Gunning was able to explain how to create prototype components that would be tested, and then later, how the approved components should be assembled and combined to complete the overall structure.

The software also enabled the crew to design a pleasing outside aesthetic with the multi-colored bricks. Initially, the group did Modo renderings with random bricks, which was what May had in mind. "It just looked mad," Gunning says. "Instead, working with the interior designer Christina Fallah, we came up with a design that emphasized stripes, giving it a bold, graphically strong look."

Construction Plans

According to Gunning, Modo gave the design team a feel for the material quality of the LEGOs in a large-scale structure well before any components were assembled. LEGOs are quite strong, he says, and when they are pieced together, they stay together nicely. (The larger, chunkier LEGOs are less sturdy when joined together.) However, LEGOs can be pulled apart by a three-year-old quite easily. "That makes it difficult to use LEGOs for most conventional building projects," he adds.

To determine the exact limitations of this novel building material, Gunning contacted Neil Thomas and Eva Wates of structural engineers Atelier One; they had pointed out, "quite surprisingly," Gunning adds, that while you can pull the bricks apart easily, there were a number of LEGO plates that have amazing tensile strength. "Neil suggested how we could build beams with a system of hollow bricks and joists that played to the compression strength of the bricks and the plates," Gunning recalls. "We realized then how we could get the floors in and a roof on the house. It was more straightforward than we had expected."

In actual construction, finite-element analysis is used to determine the limitations of the building materials. But because LEGO is not a known building material, it would have taken upwards of a year to do the proper research and analysis. With only three months to get the house designed and built, the architects had to come up with an alternate solution.

Tests on individual bricks provided some of the required information, and large-scale prototyping helped determine what worked and what did not. "The best way of working out what we could do structurally with the LEGOs was to test the big components and the beams, and see what happened." They began building beams that could span two meters (about six to seven feet). This was met with a variety of "exciting" experiences, with the early versions collapsing easily.

"We played around with this undulating wall plan, but when we mocked that up, it was a bit too flexible," Gunning recalls. "One evening we loaded up a whole section mockup of the building, with over half a ton of material, until the beams collapsed. There were thousands of LEGOs on the floor," recalls Gunning. "All the LEGOs were fine, so we just picked them up and made something else with them."

The trick, though, was to conserve the number of bricks being used while making the structure secure. After a month, the group had redesigned the building using hollowed blocks that could support James May's weight as he walked around the house. However, the production company's insurers would not allow construction to start unless a parallel timber frame was "sleeved" by the hollow segments. "We then had to redesign the house again to make it work with the timber columns," says Gunning. "Making the timber coordinate with the LEGO was difficult; the timber column could hit the LEGOs and damage them."

Building Blocks

The house was designed around the maximum space the architects could create within the limitations of the structural system, which was seven feet wide—not very big. "We had grand ambitions of creating a house where you don't feel hemmed in by this kind of dimension. We played around with the 3D organization of it in Modo, and came up with a surprisingly spacious living room, bedroom area, big windows looking out to the vineyard, a kitchen, bath…all the things you need to live in it," says Gunning.

Throughout the design and construction phases, the group had to maintain an accurate count on the number of LEGO bricks being used. "We had to make the house as big as possible with the limited number of LEGOs we had," says Gunning. Often this was a delicate balancing act. The team had to avoid making the walls too thin from a structural point of view, yet not make it too thick because too many LEGOs would be used in the process. The timber insertion, while difficult to manage, provided the necessary structural depth while utilizing a single-brick layer design for the beams.

Careful planning within Modo was necessary to ensure that the crew did not run out of LEGOs. Also, the architect used the software to come up with an optimal design for the overall structure and the furnishings inside.

Alas, after the design was completed, the group did a quick calculation and realized that at least six months of construction work would be needed to assemble the LEGOs. "We would need a lot of people, and you cannot have that on a construction site. It's way too dangerous," Gunning says. "We had to think about how we could create something that was clearly a LEGO building and constructible within the timeframe and still have some magic to it." The answer was to use components: beams and blocks would form the wall elements and could be made easily by the public and then transported to the site, while little "houses" would be used to make the large house.

An announcement was made, and nearly 3000 people answered the call to assemble the bricks into components, each of which were about a foot long and half a foot wide, and eight courses of bricks high, "something young kids can put together quickly without much difficulty," Gunning says. In a single day, 3000 components were made, "which meant that we had half the house built," he adds. The components were small enough to move around, yet were not especially fragile. Some components were used for the walls, some even with windows in them, while others formed the roof.

Modo helped the group relay the complex instructions to the public. "You need to explain to people who have no knowledge about building how to put the components together," he says. "It was important to generate clear, concise instructions, which we did in Modo. A few times we did not do that, and we had to have them redo the sections three to four times until they got them right."

Realizing they were low on LEGOs, the group asked the public to donate bricks to the cause, and most of the donated pieces were used to augment the original number. Though not usable for load-bearing construction, many of the tiny bricks that were donated were used to construct a striking stained-glass window at the top of the stairs.

Unlike at LEGOland, the house bricks were not glued together because of the time crunch. "The real nightmare was someone breaking things that were already made. Our risk was building the house several times over because of broken pieces," explains Gunning. A dedicated construction team spent about six weeks assembling the various components at the building site and constructing remaining components. Indeed, some breakage did occur, requiring the crew to put the blocks back together again. "And when things didn't go right, you could just take apart a few bricks and put them together again," he adds.

In the end, the two-story house contained large windows, a huge staircase, and hinged doors, a working toilet (with basic plumbing), and a shower. The rooms were furnished, down to the cutlery, plates, and pots and pans in the kitchen—all made of LEGOs. Unfortunately, some of the furniture fell apart when used, but the goal was achieved nevertheless.

So, what was the most daunting aspect of this project? "It was that moment when I realized that three million LEGOs is a lot of LEGOs," Gunning recalls. "The challenge was then getting them put together in way that you don't end up having to do it hundreds of times."

The house was completed in the given timeframe, and it took almost two weeks after completion before May and the film crew could record the sequence, which included May spending the night in the LEGO house. While sturdy, the house was not 100 percent waterproof. "LEGOs are not ideal for long-time construction," Gunning notes.

That was certainly the case here. After filming the segment, the house was demolished, despite public outcry and a Facebook campaign to save it, and the bricks were donated to LEGOland for use in fundraising events for charity. Still, the project appears to be the largest LEGO construction to date, one for the record books. "I can say that in all my career, I have never done anything quite like this, nor am I likely to do it again," Gunning says with a chuckle. ■

Karen Moltenbrey is the chief editor of *Computer Graphics World*.

PORTFOL

Unleashed: The Art of Naughty Dog

When you mention the name Naughty Dog, what comes to mind is a range of imagery–from the cartoon look of *Crash Bandicoot* and anime look of *Jak and Daxter*, to the painterly style and graphically detailed look of the widely popular *Uncharted* and *Uncharted 2*. The talent of the artists behind those highly acclaimed titles is as diversified in genre and medium as the aesthetics of the game art they create. Collectively, they produce amazing works admired throughout the computer game industry. Individually, they are artisans, pursuing their own passion outside of the work arena with the same intensity and creativity they illustrate daily at their desk.

Now, the public has the opportunity to see the scope of their talent that transcends the video game arena, as a number of these Naughty Dog colleagues display their art at the Gnomon School of Visual Effects' on-campus gallery in Los Angeles. The exhibit features approximately 30 pieces, which range from traditional and digital sculpture, to photography, to matte paintings, and more.

"Naughty Dog obviously has been around for many years and has always been a top game studio. The quality and caliber of the work they are doing as a team just gets higher and higher," says Gnomon founder Alex Alvarez. "Now we get to see their personal art, who they are as individuals." The gallery artwork is strictly personal work, he adds, though many continue to do fantasy art that has a fantastical, sci-fi feel and vibe–some more so than others.

Gnomon opened its gallery a few years ago, enabling a number of talented folks–many who lecture and teach at the school or work on DVDs for The Gnomon Workshop–to display their works. Most galleries in Los Angeles focus on fine art, leaving the entertainment artists with few available venues. "To me, the artists we know who are focused on games and entertainment are among the most talented in the world, and I think many others feel the same way," says Alvarez. "That is why we decided to put this gallery together."

Former student Melissa Altobello, now at Naughty Dog, had approached Alvarez about featuring pieces from her colleagues at the school. "I think it is inspiring for the students to see this caliber of artwork that the professionals are doing. It gives them a target and shows them why they are at the school," he says.

A selection of images from the Naughty Dog group is presented on these two pages. *–Karen Moltenbrey*

OPPOSITE PAGE, CLOCKWISE FROM TOP LEFT

Buggle Takeoff Shaddy Safadi was inspired for this piece while trekking in Northern Borneo, where she visited Deer Cave.

The Life Giver An all-digital piece by Genesis Prado. "I was trying to portray how the nymphs of the forest give and take life as an example of a cycle of life. I wanted to portray life as something to be cherished and not taken for granted."

Annapurna Base Camp Carlos Gonzalez-Ochoa's panorama of the Annapurna South mountain at sunrise. Photos from the trip were heavily used as reference for *Uncharted 2*.

THIS PAGE, CLOCKWISE FROM TOP LEFT

Home Sweet Home Melissa Altobello created this piece wherein the ground crumbled away, in a nod to the recent natural disasters.

Sam A digital photograph that was part of a lighting experiment by Hong Ly.

Steam Punk Village A painting by Robh Ruppel following completion of *Uncharted 2*.

Escape #1 Andrew Kim strived for a simple but dynamic scene in a steampunk/sci-fi style. Strong diagonal lines in perspective made this possible, and a simple background made the characters/objects stand out.

PRODUCTS

For additional product news and information, visit CGW.com

GDC Goodies

This page is dedicated to product announcements made during the 2010 Game Developers Conference held last month in San Francisco. For more news from the annual industry event, visit www.CGW.com or www.gdconf.com.

SOFTWARE

GAME DEVELOPMENT

Social 3D Solutions

During GDC, Dassault Systèmes (DS) announced the public beta of 3DVIA Studio and 3DVIA Scenes, applications that enable realistic, 3D online experiences. The new 3DVIA offerings combine social media with content creation apps and reusable 3D content to simplify the 3D content creation process. 3DVIA Studio is a 3D development environment for programmers and artists to create complex, interactive games, simulations, serious games, and Web-based applications. 3DVIA Scenes, a Web-based, multi-user 3D application platform targeted at creative professionals and 3D enthusiasts, features a drag-and-drop interface enabling users to build online applications using 3D models and pre-programmed 3D "smart objects" developed and shared through the 3DVIA content warehouse. The two new applications are free for non-commercial use during the beta period.

Dassault Systèmes; www.3ds.com WIN

Gamebryo LightSpeed

Emergent Game Technologies, a provider of 3D game development solutions, has updated its Gamebryo LightSpeed development engine. New features include the launch of LightSpeed's "Kickstart" program, whiteboxing capabilities, additive animation blending, and support for the LightSpeed D3D11 renderer. A starting point for evaluation, rapid prototyping, and development using LightSpeed, Kickstart includes tutorials, documentation, videos, sample game code, and game assets. The new whiteboxing tool helps game designers rapidly prototype simple, playable levels to test gameplay and then deliver the whiteboxed level to artists for texturing and lighting. Emergent also announced a new source distribution method for LightSpeed, giving developers access to three branches of engine code: Development, Beta, and Release.

Emergent Game Technologies; www.emergent.net WIN

Images courtesy Michel Rousseau.

New Nova

Vertice introduces its Nova 2010 real-time 3D engine with support for DirectX 10, shaders 4.0, and multi-touch technology, as well as compatibility with Nvidia's 3D Vision technology. Nova 2010 also features a new physical engine, post-process effects, and a real-time shadows engine. Nova Web Player now works with Internet Explorer, Firefox, Opera, Safari, and Chrome. Nova 2010 also supports 64-bit systems, and FBX, DXF, OBJ, 3DS, DAE, and X file formats. Ambient occlusion through the attenuation of lights and shadows adds more realism to the scenes and rounds out Nova 2010.

Vertice; www.vertice.fr WIN

CHARACTER MODELING AND ANIMATION

Poser Pro 2010

Smith Micro Software's Productivity and Graphics Group has launched Poser Pro 2010, for professional artists and production teams to add 3D characters to their projects. Poser Pro 2010 boasts more than 2.5GB of ready-to-use content, including pre-rigged, textured 3D characters. The 2010 version also features improved rigging, an enhanced user interface, a new content management system, and a variety of new tools, including: Dependent Parameter, Cross-Body Part, StuffIt Connect and Facebook image uploading, Physically Correct Light Falloff, Tone Mapping and Exposure, and Wardrobe Wizard. Poser Pro 2010 users gain the ability to integrate characters within other applications, such as Autodesk's 3ds Max and Maya. Poser Pro 2010 is priced $500 with upgrades from the previous version of Poser Pro priced at $200.

Smith Micro Software; www.smithmicro.com WIN MAC

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PRODUCTS

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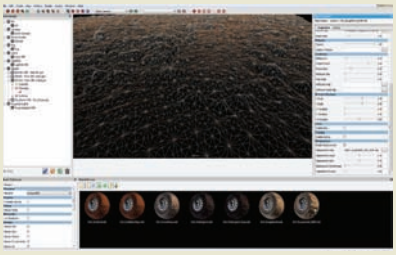
REAL-TIME 3D

MachStudio Pro 1.4

StudioGPU has unveiled MachStudio Pro 1.4 with new features and functionality for real-time, 3D workflow, including physically-based cameras, the ability to export directly into layered Adobe Photoshop files, a materials ID renderer, procedural ramp texture generation on projected lights, and added Python programming functionality. MachStudio Pro also enables artists, designers, engineers, directors, and technical directors to manage and interact with complex lighting, caustics, cameras, shaders, materials, ambient occlusion, and color grading for real-time shot finaling and compositing. The company has unveiled a Softimage exporter for MachStudio Pro, a software-only version of MachStudio Pro, and support for leading workstation graphics accelerators. Customers now have the option to purchase MachStudio Pro in a value-added bundle with AMD's ATI FirePro V8750 workstation graphics accelerator, enabling them to take advantage of MachStudio Pro features exclusive to ATI accelerators,



such as real-time hardware tessellation and displacement mapping. MachStudio Pro supports Microsoft Windows 7, Windows XP Professional, and Windows Vista operating systems. MachStudio Pro software is now available in North America for $3999 or bundled with the AMD ATI FirePro V8750 3D workstation graphics accelerator card for $4999.

StudioGPU; www.studiogpu.com WIN

FACIAL ANIMATION

Faceware for Games

Image Metrics, a provider of facial animation technology and services for the entertainment industry, has launched its Faceware facial animation technology platform. Faceware is designed to integrate into virtually any pipeline and game engine, deliver a streamlined animation process, and increase creative control, efficiency, and production speed. Faceware is now available for use with popular 3D software packages. Image Metrics also provides training for studios learning to use Faceware, as well as offers facial-animation services to developers preferring to outsource facial animation.

Image Metrics; www.image-metrics.com

www.aja.com

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Ki PRO

On set, Ki Pro lets you to shoot on the same codec that you edit with - Apple ProRes 422. With extensive analog and digital connectivity, virtually any video and audio source can be fed into Ki Pro, which uses AJA's powerful 10-bit realtime up/down/cross conversion, to enable instant recording of SD or HD from any camera format.

On the desktop

KONA

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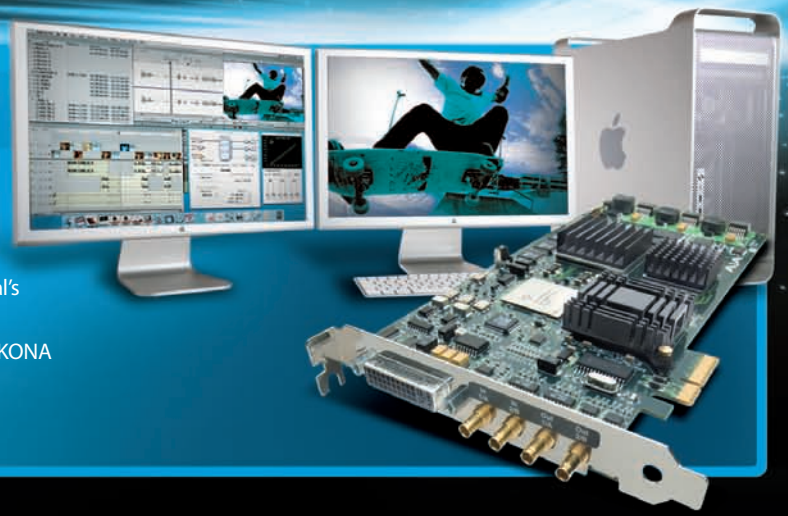

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