The Computer Graphics Wars Heat Up

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The 2002 ACM Siggraph Conference, held in San Antonio, reminded the computer science community that we live in the best and worst of times. The small turnout of 16,000 surprised no one, given how economic setbacks and tragic world events dampened travel this past year. Old-timers remarked that this conference's much-reduced attendance recalled the graphics world's youth, when ACM held Siggraph in small venues such as Boston.

A STAR IS BORN—AGAIN

The computer graphics community left those small-town beginnings behind when digital animation and special effects made Siggraph the darling of Hollywood. SGI carried the torch for the conference in the mid-1990s. Its hardware proved key to the success of such blockbuster movies as *Jurassic Park* and *Terminator 2* (http://sgistuff.g-lenerz.de/movies/). Studios such as Walt Disney and George Lucas's Industrial Light and Magic rushed to buy costly workstations that would fulfill filmmakers' demand for more and better computer animation.

How ironic, then, that ILM announced at Siggraph 2002 it has deployed 600 Pentium 4 PCs for use in future animation projects. The graphics shop plans to use these PCs as the new graphics engines that will help produce the next set of sequels for the *Star Wars*, *Terminator*, and *Harry Potter* franchises.

Despite a small turnout, this year's Siggraph conference unveiled several huge developments in the computer graphics industry.

CONSOLES DOMINATE GAME SALES

The computer game world continued to have a major presence at the conference. In 2001, the US game industry grossed $6.3 billion despite a global recession and the intensifying battle for market share triggered by Microsoft's entry into a console market already split between Nintendo and Sony (http://www.idsa.org).

Yet while console games flourished, PC game sales plummeted, plunging most of their publishers into depression. Companies like Alienware, which sells dedicated gaming rigs, provided some of the PC industry's few success stories. Alienware's white-box machines—which cost $3,000 and target the high-end, serious-gamer market—are the antithesis of the bargain-basement Dells and Gateways sold to the mass market.

The game companies attending this year's Siggraph mostly sought to recruit new talent. Scott Owen, ACM Siggraph Conference Advisory Group Chair, noted that mammoth console and PC game publisher Electronic Arts employs roughly 2 percent of the conference's attendees. Overall, the game industry seems impervious to the economic downturn, and it has been hiring both programmers and artists for a plethora of platforms.

CLASH OF THE GRAPHICS BOARD TITANS

Despite the hoopla surrounding game- and special-effects-related developments, the real action at this year's Siggraph took place between the 3D graphics world's two dominant players. Both Nvidia (http://www.nvidia.com) and ATI (http://www.ati.com) have their roots in the workstation graphics world.

Dave Orton, president and COO of ATI, previously ran SGI's visual computing business and oversaw the ONYX Infinite Reality line; SGI dubbed the ONYX a graphics supercomputer. Orton later left SGI to join ArtX, which Nintendo selected to design the graphics for their GameCube console. Veteran PC graphics card manufacturer ATI acquired ArtX in February 2000, and Orton joined the company with the mission of rejuvenating its stagnant 3D graphics board line.

Likewise, two of Nvidia's three cofounders came from Sun in 1993. Vice president for Hardware Engineering Chris Malachowsky and CTO Curtis Priem developed Sun's GX graphics products, including the world's first single-chip GUI accelerator.

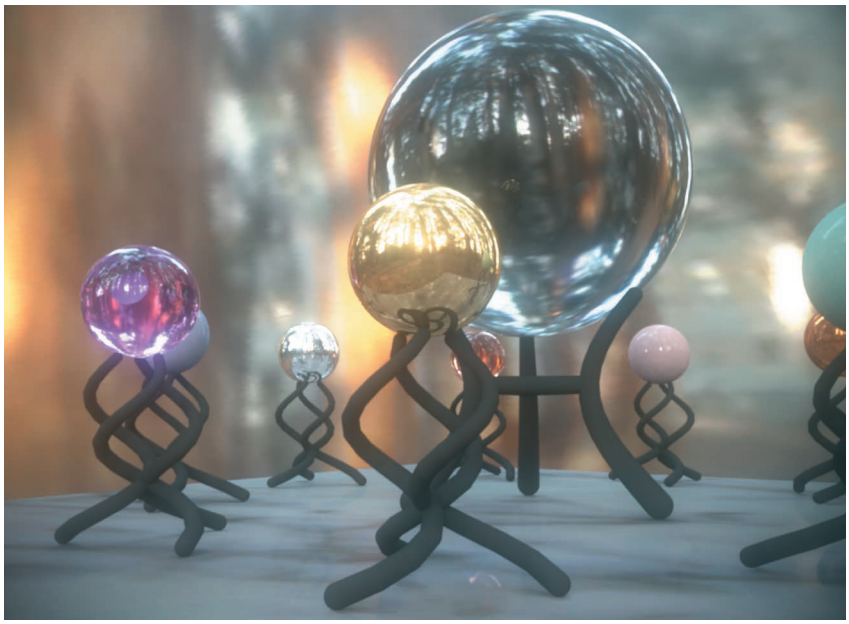

Figure 1. Paul Debevec's demo of* Rendering with Natural Light *on ATI's newest Radeon board rendered complex images such as this in real time at 60 Hz.

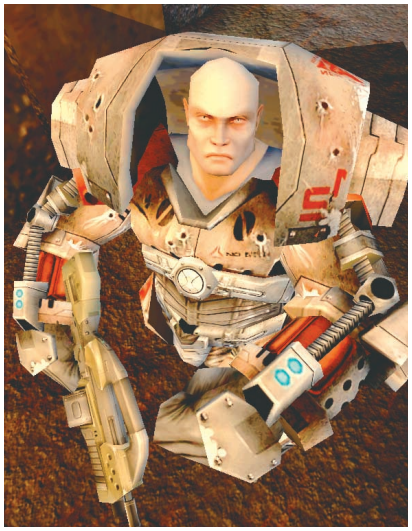

Figure 2. This futuristic soldier from* Unreal Tournament 2003 *hints at the impressive graphics Nvidia's NV30 will bring to computer games.

Nvidia shines

Nvidia made its usual splash at Siggraph. Chief Scientist David Kirk, an Apollo/Hewlett-Packard veteran, received the Siggraph Computer Graphics Achievement Award "for his key technical role in bringing high-performance computer graphics to the mass market." The company's GeForce 4 line had, up until August, boasted the fastest consumer-level graphics chip on the market and thus the most popular engine for 3D graphics cards.

Nvidia also supplies the graphics for Microsoft's Xbox. Further, Nvidia CEO Jen-Hsun Huang made the July cover of *Wired* magazine by saying he would make the PC's central processing unit obsolete by moving its workload to specialty chips (http://www.wired.com/wired/archive/10.07/Nvidia.html).

Dark portents?

August, however, brought a host of new worries for Nvidia. First, among the current generation of consoles, Xbox remains third in sales. Microsoft reported in July that it had sold only 3.9 million Xboxes, compared to Sony's 33 million PlayStation 2 units sold. Meanwhile, Nvidia competitor ATI seems to have found a more lucrative partner in Nintendo, which forecasts sales of 16 million GameCubes by March 2003 (http://nintendo.com/news/index.jsp).

Nvidia has also suffered setbacks in its arbitration with Microsoft regarding the price it can demand from the software giant for the Xbox video chips it makes. Nvidia has disclosed in filings with securities regulators that it may be forced to produce the chips at a loss if Microsoft wins the case.

Finally, at Siggraph, ATI unveiled its newest graphics board, the Radeon 9700 Pro with its R300 chip. As gamers would say, this board rocks. The 9700 substantially outperforms Nvidia's GeForce 4 (http://www.hothardware.com/hh_files/S&V/radeon9700pro.shtml). Its eight parallel rendering pipelines, reminiscent of Dave Orton's ONYX developed at SGI, process up to 2.6 billion pixels per second—in effect making the board a graphics supercomputer.

The board also supports floating-point frame buffers and has a 256-bit-wide bus, twice that of the GeForce 4. This enables the Radeon board to display high-dynamic-range images in real time, dramatically enhancing the realism of a computer-generated image.

Paul Debevec, one of HDR's developers, demonstrated ATI's recreation of his famous *Rendering with Natural Light*, shown in Figure 1, on the Radeon. In the original 1998 film, it took 20 minutes to render each frame. This year, on the Radeon set up at Siggraph, Debevec rendered the entire work in real time at 60 Hz, speeding up the process by a factor of 72,000 (http:// www.debevec.org).

However, Nvidia let it be known that it has a new threat in development. The NV30 will likely ship by December—Nvidia sent the chip's final design to manufacturing in August. The NV30 will supposedly include a new cinematic graphics-processing unit that promises to render in *real time* animation comparable in quality to that seen in *Toy Story*.

LEAP OF FAITH

Legendary game designer and id Software CEO John Carmack noted in a Siggraph press release that Nvidia's

convergence of customer real-time and professional offline rendering will provide a step forward that makes all his previous work—including that on the newest installment of *Doom*—outdated. This leap will be accomplished by the NV30, which for the first time goes beyond simply extending existing technology or padding it with additional features. According to Carmack, his next-generation work will be designed specifically to take advantage of the NV30's capabilities to produce graphics like those shown in Figure 2 (http://www.nvmax.com/Articles/Previews/NV30_SNEAK_PREVIEW/).

Nvidia plans to make this performance leap by leveraging several technologies. First, it will move its chip manufacturing from a .15-micron to a .13-micron process, which should allow clock cycles to increase. The company will also copy ATI by adding a 256-bit bus and floating-point frame buffers. But the magic will likely lie in the new chip's programmability, which will give game developers more power to render geometric images and textures.

It's a big risk, with ATI having a four-month lead on Nvidia. Further, the move to a .13-micron process is fraught with design risks (http://www.lostcircuits.com/video/nvidia_nv30/).

Meanwhile, both Nvidia and ATI are being challenged—albeit quietly—by Intel. The chip maker needs these companies to attract high-end gamers to its P4 line. Although Intel has partnered with Nvidia on the Xbox, it's also seeking more revenue from its support chips, such as its low-performing 845 chip.

Considering the powerful graphics capabilities Intel's workstation-class machines displayed at Siggraph, it seems unlikely that the company's 3GHz machines, due to debut this Christmas, will be used only to run Office XP.

Siggraph will slowly make its way back to the entertainment heartland. The conference will be held in San Diego in 2003 and return to Los Angeles in full force in 2004. By that time, the competition between ATI and Nvidia for the hearts and minds of the graphics world may be settled. Or they may both have lost to Sony and Intel. ■

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