Why the PC Will Be the Most Pervasive Visualization Platform in 2001

Organizer:
Hanspeter Pfister, MERL

Panelists:
Michael Cox, MRJ / NASA Ames and NVIDIA
Peter N. Glaskowsky, Cahners MicroDesign Resources
Bill Lorensen, General Electric CRD
Richard Greco, Intel

INTRODUCTION

Graphics accelerators for PCs are becoming more powerful and cheaper almost every month. What impacts does this development have on scientific visualization? Everybody agrees that there is a market pyramid with a high end at the pinnacle. But budgets are shrinking for those machines. And as the PC moves up in performance and features it becomes harder to justify incremental advantages for astronomical cost. Is this the end of "big iron vis"? Are we moving towards — gasp — "consumer vis"? What are the implications?

The four panelists will give 15 minute presentations, trying their best to stir some controversy, followed by a hopefully heated and lively discussion with the audience. All panelists have been offered immunity from prosecution based on any statements, posing, or posturing, implied or actual, that may occur in this panel. Their employers will vehemently deny any knowledge of their participation.

The panel will be moderated by Dr. Hanspeter Pfister, Research Scientist at MERL — A Mitsubishi Electric Research Laboratory in Cambridge, MA. He is the chief architect of VolumePro, Mitsubishi Electric's real-time volume rendering system for PC-class computers. Despite his obvious inclination towards consumer PCs, Dr. Pfister will try to give the illusion of being an impartial panel chair.

POSITION STATEMENTS

Michael Cox

If history and inertia are valid indicators, it is clear that it will be quite some time before the PC is accepted as the platform of choice for scientific (or for that matter any other) visualization. The platform of choice will continue to be $100K+ high-end graphics workstations because of a force far more powerful than technology and market forces — human nature. Consider that the yearly maintenance fee for the "highest-end" graphics workstation is significantly more than the yearly cost to buy the new highest-end NT graphics PC every year. And consider that in spite of better CPU and graphics performance on the NT PC, most visualization researchers resist moving from their current machines with the same vigor that FORTRAN programmers resisted abandoning the VAX and VMS. Of course those who cling to their "high-end" Unix graphics workstations can and do give numerous technical arguments for their patriotism. We will explore these arguments in detail. We will also explore the counterpart arguments made by die-hard VAX VMS aficionados. In so doing we will see clearly that Unix graphics workstations will not die any more than the VAX and VMS died — VAX and VMS were replaced by a newer generation of machine when the programmers were replaced by a newer generation of college grads.

Peter N. Glaskowsky

Rapid advances in PC graphics performance, and adoption of advanced rendering techniques such as ray tracing and volume rendering make it inevitable that the PC platform will soon be the most popular choice for visualization applications.

Cost pressure on PC graphics and system vendors will prevent PCs from completely eliminating the workstation market, however. Professional users can benefit from performance beyond what PCs offer, and this benefit creates a natural — and permanent — opportunity for higher-priced workstations with better visualization capabilities.

Bill Lorensen

In 1984, I was able to render 2000 triangles / second on a $200,000 Vax 11/780 (which I shared with about 30 other researchers). Today, at home, I can render 200,000 triangles on a $2,000 Pentium 450.

The driving forces behind computing technology have changed. This is especially true for computer graphics technology, a core technology for visualization. In the 70's, 80's and early 90's, industry and research communities dictated the direction of hardware and software. Aerospace, automobile and biomedical requirements were eagerly met by companies that sold big iron for big bucks. Although the hardware was expensive, it was robust and reliable. We became comfortable with predictable increases in price performance. And during these twenty five years, we scoffed at the personal computer, at first tailored for hobbyists and later for office applications. The PC lacked the sophisticated software development environments that the Unix vendors provided. Although fast for some specific applications, the PC's were not balanced for the mixed work load that scientists and engineers need.

Today, many of us still ridicule the PC and criticize its immaturity. But no one is listening. Fueled by the mass market demands of entertainment and gaming, the PC now offers fast CPU's coupled with low cost graphics acceleration. The PC is accepted in the industrial engineering community. It is becoming more accepted in the scientific community. $200 graphics accelerator cards are outperforming some of our best Unix workstation graphics. And certainly, some of these PC accelerators have a better price-performance rating.

Visualization folks need to wake up and learn how to solve problems and deliver products using the fast graphics / CPU performance available on the personal computer. The software development environments on the PC are getting better and in some instances provide better tools than we have on Unix systems.

During the panel, I will discuss the transition we have made from pure Unix development to mixed Unix / Linux / PC development. I will share our experiences (good and bad) in making the transition.

Richard Greco

Coming from Intel, I use the term "PC" differently than people outside of Intel. To me a "PC" is a computer oriented towards the home or business desktop types of applications. Computers addressing this market use lower cost commodity disk I/O, smaller memory capacity, and lower end processors to meet a more aggressive price point than a workstation. 3D accelerators are optimized for games, with aggressive workloads typically in the range of thousands of polygons, of large average size, and heavy use of textures for surface details. Unless the 3D canyon is bridged in the next year driving up 3D accelerator requirements, I do not believe a computer fitting this description will be the pervasive visualization platform in the year 2001.

However, a workstation built with an Intel Processor is not a PC. Intel-based workstations use 3D accelerators designed to the same design centers of any workstation, in some cases the same accelerator as a RISC platform. The same high performance commodity disk drives, memory, and PCI I/O peripherals are present in these systems as their RISC counterparts. What separates them from their RISC-based counterparts is single CPU floating-point performance, and in some cases bus bandwidth. With the far lower price point of multi-processor Intel based workstations, workloads able to use multiple processors can close this performance gap. Additionally many visualization tasks involve viewing data computed on a larger system. For this type of workload, single CPU performance is typically not an issue. For these reasons I believe workstations based on Intel processors will be the pervasive visualization platform in the year 2001.

BIOGRAPHIES

Hanspeter Pfister is a Research Scientist at MERL — A Mitsubishi Electric Research Laboratory in Cambridge, MA. His research interests include computer graphics, scientific visualization, computer architecture, and VLSI design. He is currently the chief architect of VolumePro, Mitsubishi Electric's real-time volume rendering system for PC-class computers. Hanspeter Pfister received his PhD in Computer Science in 1996 from the State University of New York at Stony Brook. In his doctoral research he developed Cube-4, a scalable architecture for real-time volume rendering. He received his Dipl.-Ing. degree in electrical engineering from the Department of Electrical Engineering at the Swiss Federal Institute of Technology (ETH) Zurich in January 1991. He is a member of the ACM, the IEEE Computer Society, and the Eurographics Association.

Michael Cox is a senior research scientist at MRJ / NASA Ames Research Center, where he works primarily on techniques for the visualization of extremely large data sets. He also serves as a part-time graphics architecture consultant with Nvidia Corporation, maker of high-end-consumer graphics accelerators for the PC platform. He has worked on graphics hardware architecture at Intel, S3 Inc., and Sun Microsystems, on computer networking at Sun Microsystems and Advanced Computer Communications, and in solar energy research and development for Altas Corporation. He received his Ph.D. in Computer Science from Princeton University in 1995.

Peter N. Glaskowsky is a senior analyst with Cahners' MicroDesign Resources. Peter is the industry's leading technology analyst for 3D and multimedia products. Prior to joining MDR, he worked at Integrated Device Technology, where he was a chief engineer in the Systems Technology Group.

Bill Lorensen is a Graphics Engineer in the Electronic Systems Laboratory at GE's Corporate Research and Development Center in Schenectady, NY. He has over 30 years of experience in computer graphics and software engineering. Bill is currently working on algorithms for 3D medical graphics and scientific visualization. He is a co-developer of the marching cubes and dividing cubes surface extraction algorithms, two popular isosurface extraction algorithms. His other interests include computer animation, color graphics systems for data presentation, and object-oriented software tools. Bill is the author or co-author of over 60 technical articles on topics ranging from finite element pre / postprocessing, 3D medical imaging, computer animation and object-oriented design. He is a co-author of "Object-Oriented Modeling and Design" published by Prentice Hall, 1991. He is also co-author with Will Schroeder and Ken Martin of the book "The Visualization Toolkit: An Object-Oriented Approach to 3D Graphics" published by Prentice Hall in November 1997. He gives frequent tutorials at the annual SIGGRAPH and IEEE Visualization conferences.

Bill holds twenty six US Patents on medical and visualization algorithms. In 1991, he was named a Coolidge Fellow, the highest scientific honor at GE's Corporate R&D.

Richard Greco is a Senior Staff Engineer in Intel's ISV Performance Lab, where he leads a team involved in all aspects of software performance for workstation and server platforms. In his career he has been responsible for architecture and performance on platforms ranging from the Atari ST to the ASCI Red Supercomputer, primarily focused on high performance graphics and graphical user interfaces. Drawn to any application area that stresses the limits of workstation platforms, his current interests are in the merger of high performance interactive graphics with interactive video editing, photorealistic rendering, and interactive visualization of large data sets.