Computer Games and Viz: If You Can't Beat Them, Join Them

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Motivation and Key Issues

Historically, the visualization community has been a driving force in high-end computer graphics innovation, fostering new technologies that gradually filtered down to the consumer market. However, in recent years, the financial growth of the computer games market has made it the driving force of consumer graphics. How do trends and advances in computer games impact the scientific and information visualization community? This panel addresses this issue by highlighting the following items:

- How are visualization displays and paradigms influenced by interactive user interfaces and visual metaphors of game design?
- Are 3D visual thinking and visualization hindered or enhanced by 3D computer games?
- To what extent are visualization and visual simulation requirements altered or affected by games-driven enhancements to major application programming interfaces (for example, Direct X and OpenGL)?
- How do short release cycles affect driver stability and completeness of driver implementations?
- Will a computer-games focus produce a lack of advanced rendering features that could stifle visualization research?
- Is there a conflict between acceptable levels of accuracy and quality for artifacts in game development versus scientific and information visualization?
- Will the rapid pace associated with computer-games development be compatible or in conflict with the requirements of the visualization community?
- Will the computer-games arena provide the funding and research to improve graphics performance and price for the computer graphics field in general and visualization specifically?[1]

Theresa-Marie Rhyne

Fundamentally, computer games are about play, and scientific and information visualizations are about knowledge. It is possible to learn about how communities develop from computer games like SimCity (www.simcity.com) and The Sims (www.thesims.com). It is also possible to find "joyful curiosity" in scientific or information visualization. Could it be said that application of visualization techniques to urban planning is an intellectualized version of SimCity? Perhaps one of the impacts computer games will have on people is to prepare them to use visualization, virtual reality, and visual simulation to examine scientific problems and local community concerns. Artistically, computer game designs are influencing visualization paradigms and facilitating 3D visual thinking. One challenge is to ensure that there is some scientific accuracy in the content of computer games. Given the recent focus on computer gaming consoles, there still needs to be functionality in computer graphics tools to support scientific and information data models. The rapid pace of computer games development needs the calm and quiet zone of scientific and information visualization to allow for steady progress of advanced rendering techniques. Perhaps there is a symbiotic relationship here.

Theresa-Marie Rhyne is an independent consultant in visualization and 3D computer graphics. From 1990 to 2000, she was a government contractor (initially for Unisys Corporation (1990-1992) and then for Lockheed Martin Technical Services (1993-2000)) at the US EPA Scientific Visualization Center, where she was the founding visualization expert. She has organized courses and panels for previous IEEE Visualization and ACM SIGGRAPH conferences. She was IEEE Visualization 1998 and 1999 co-chair and a director-at-large on the ACM SIGGRAPH Executive Committee from 1996 to 2000. Currently, she is the project director of ACM SIGGRAPH's outreach to the computer games community.

Peter K. Doenges

Rapid development of 3D computer games fuels rampant hardware and software innovation. 3D games are surpassing professional 3D graphics and real-time visual simulation in certain areas. Game 3D technical innovation might benefit scientific and information visualization, but the technology is wired for different objectives. Scientific visualization seeks system understanding and values discovery. It needs flexible interfaces and programming via stable APIs for basic insights into forests of data. It also needs accuracy in multivariate data, data scalability and CPU-graphics bandwidth, and inter-processor communication. 3D games and Vis Sim focus on challenging human performance with fast fixed-function rendering of virtual worlds and landscapes for vital human experiences. Commercial predominance of 3D PCs and consoles could strand scientific visualization without needed features.

Cross-pollination is attractive, but challenges exist for derivative products to serve scientific visualization. Recent 3D game hardware turns to micro-coded pixel shaders, procedural vertex geometry, high micro-polygon densities, animating very large meshes, 2D/3D texture for illumination and reflection, and multi-texturing for pixel pipelines and cascaded separable functions. Developers wonder if PC 3D can scale up in multiple CPUs and 3D boards, if adequate data accuracy, bandwidth relief, viable inter-processor software, and frame-buffer access were available. Such graphics clustering invites balancing system resources and synchronization. It's time to stimulate dialog about what configuring “3D in the small” can do for scientific visualization, and how scientific visualization algorithms could adapt to new architecture. Pertinent lessons emerge from large-scale geographic visual simulation with PC 3D.

Peter K. Doenges earned a BSEE from the Rose-Hulman Institute of Technology and a MSEE from Syracuse University. He is vice president of strategic technology at Evans & Sutherland, where he has been responsible for IG hardware/software, modeling tools, radar/sensor simulation, driving dynamics, early ASIC work, systems engineering, marketing, engineering business, and R&D. He is involved in curved surface and procedural shader R&D and convergence of professional and game 3D technologies with OpenGL and DX. He is member of the IEEE Computer Society, ACM SIGGRAPH, Tau Beta Pi, NSIA/ADPA, Computer Graphics Pioneers, the IMAGE Society Board of Directors, and the RHIT Industrial Advisory Board. He represents Evans & Sutherland with the Web3D/VRML Consortium, participates in the OpenGL ARB, and chaired MPEG-4 Synthetic/Natural Hybrid Coding for streaming 3D. For over 30 years, he has worked in real-time visual simulation and 3D computer graphics. He began with the GE Electronics Laboratory in IG R&D, computer film animation for NASA’s Space Shuttle, real-time hardware/software for shuttle simulation, and USAF ASUPT scene generators.

Chris Hecker

Since most of the other panelists are coming at this question from the scientific visualization side, I describe the situation from the games side. How does the games community see the scientific visualization community? What are the advanced features that we beg hardware vendors to implement, and how do those features overlap with features needed by the scientific visualization community? And, from a slightly different perspective, how do game developers use scientific visualization techniques during development (or even during the end-user’s play experience), and what does this mean for the relationship between the communities?

Chris Hecker is technical director at definition six, inc., a small game development company working on high-end physics and graphics technologies. He has been on the advisory board for the Game Developers Conference for many years and is a regular speaker at the GDC, the annual SIGGRAPH conference, and other conferences. He was co-organizer of the SIGGRAPH 2000 Course on Games Research: The Science of Interactive Entertainment and moderated the SIGGRAPH 99 panel on How SIGGRAPH Research is Utilized in Games. A frequent contributor to Game Developer magazine, he was the technical columnist for the magazine for two years and is currently editor-at-large. He is also on the editorial board of the computer graphics research publication, The Journal of Graphics Tools.

William Hibbard

For many years, visualization users bought their graphics hardware from SGI, who built it for them. Now they buy their graphics hardware dirt cheap from NVIDIA and ATI, who build it for people who want to play computer games. So the visualization community has already been revolutionized by computer games.

Since the graphics vendors are building for the gamers, they don’t listen to scientific visualization people. But it will work out alright in the long run, since graphics hardware will have to be abstract, programmable, and interoperable in order to serve the needs of gamers. That is, graphics APIs will have to abstract in order to make the wide variety of images that gamers need, so they will be able to make the images that scientific visualization people need. Graphics APIs will need to be programmable to attract a large community of game developers, so they will be programmable by scientific visualization people. And graphics APIs will need to be interoperable, in order to support multi-player games.

Networked computer games will be the medium of the 21st century in the way that movies and TV have been the media of the 20th. So in the short run the graphics market is in turmoil as vendors jockey for a bigger piece of this huge gaming pie, but in the long run the graphics hardware necessary to support gaming will be as stable and cheap as television. The era of special-purpose hardware is being replaced by the era of Toys-R-Us.

William Hibbard is a scientist at the Space Science and Engineering Center of the University of Wisconsin–Madison. He was principal investigator of the NASA grant that supported development of the Vis5D, Cave5D, and VisAD visualization systems. These systems are widely used to visualize numerical simulations of the Earth’s atmosphere and oceans. He was an investigator of the Blanca Gigabit Testbed network, studying the use of high-speed wide-area networks for interactive visualization. He has been a member of the Program Committee of the IEEE Visualization Conferences since their inception in 1990. He also writes the VisFiles column in Computer Graphics, the SIGGRAPH newsletter.

Hanspeter Pfister

Without question, technical advances in computer graphics are driven by games and entertainment. Computer games are the “killer application” for 3D graphics, and they will play this role for the foreseeable future. Consequently, we have seen an unprecedented rise in graphics performance and features in the PC gaming market. Very soon, you will be able to buy a mid-range PC with a 1GHz CPU and about a gigapixel fillrate. Recent features of commodity graphics cards include multi-texturing, hardware transform and lighting, full-scene anti-aliasing, and bump mapping. Very soon, we will see hardware support for vertex blending, texture transformations, shadow mapping, and 3D textures.

I think this is great news for the scientific visualization community. However, I dare to raise a word of caution. Let's not forget that many advanced rendering features, such as a wide range of pixel and texture formats, are not available on PCs. Let's not forget that PCs suffer from vastly lower I/O performance and smaller memory capacity than high-end graphics workstations. Let's not forget that the extremely short release cycles of the commodity market lead to unstable and incomplete graphics drivers. And let's not forget that PC games are driving the future development of our graphics APIs. What will happen if OpenGL is not able to compete with Direct3D anymore? Will an API controlled by Microsoft fulfill the needs of high-end visualization? I believe the scientific visualization community has a responsibility to speak out. Microsoft, Intel, and other vendors will listen to a market that is projected to reach $US 13 billion in 2005. Maybe it is time to form an interest group for scientific visualization that addresses these issues.

Hanspeter Pfister is a research scientist at MERL - A Mitsubishi Electric Research Laboratory in Cambridge, Massachusetts. He is the chief architect of VolumePro, Mitsubishi Electric's real-time volume rendering system for PC-class computers. His research interests include computer graphics, scientific visualization, computer architecture, and VLSI design. He 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 in 1991. He is a member of the ACM, IEEE, the IEEE Computer Society, and the Eurographics Association.

Nate Robins

Computer games are a powerful driving force in the consumer graphics market. They have brought much of the power from what is normally referred to as the "big iron" down to the consumer desktop. As the computer gaming industry continues to burgeon, more of the capabilities normally associated with high-end graphics hardware will trickle down to the average consumer. This is leading to the possible demise of many of the pioneer graphics vendors, including SGI and Evans & Sutherland. Fundamentally, however, the gaming industry is not an innovator in the graphics arena. It is a consumer. They need the high-end industries, such as visualization, to be the driving force in graphics technology. Because the games industry is driven by a market that has an extremely short product cycle, there isn't much time for innovation beyond proven techniques, many of which are in use (or were invented) by the visualization community today. The visualization community could benefit from watching the games industry and keeping them informed of new innovations that they'd like to see become mainstream. If you invent it, we'll make it popular.

Nate Robins works for Avalanche Software. He is not a very competent video game player, but he really likes the problems involved in making them. He received a bachelors degree from the University of Utah, where he worked with Chris Johnson in the scientific computing and imaging group on the "Big Iron" project. He has also worked for Parametric Technology Corporation, Evans & Sutherland, SGI, and Acclaim Entertainment.

Reference

1. T.-M. Rhyne (2000), Computer games' Influence on scientific and information visualization, IEEE Computer, 33, (12), 154-156.