The Impact Of Computer Games On Scientific & Information Visualization: "If you can't beat them, join them"

Organizer:
Theresa-Marie Rhyne, Lockheed Martin/ US EPA Sci Vis Ctr.

Panelists

Peter Doenges, Evans and Sutherland
Bill Hibbard, University of Wisconsin at Madison
Hanspeter Pfister, Mitsubishi Electric Research Laboratory (MERL)
Nate Robins, Acclaim Entertainment, Inc.

Motivation and Key Issues:

The computer games industry is one of the most important and innovative components of the computer graphics field. 1999 Market Research indicates that the financial revenue generated in computer or video games purchases exceeded the box office sales associated with the traditional entertainment arena of motion pictures. Today, game developers are significant pioneers in the context of bringing high-end graphics technology to volume consumer platforms. We are also seeing cutting edge computer graphics hardware designs coming from the computer games industry. The Sony Playstation II and potential release of Microsoft's X-Box are such examples.

How do trends and advances in computer games impact the scientific and information visualization community? This panel attempts to begin addressing this issue by highlighting the following items:

To what extent are visualization and visual simulation requirements altered or impacted by computer games driven enhancements to major Application Programming Interfaces (e.g Direct X & OpenGL)?

How do the short release cycles affect driver stability and completeness of driver implementations in terms of visualization criteria?

Will a computer games focus result in a lack of advanced rendering features that could stifle visualization research?

Is there a conflict between the acceptable levels of accuracy and quality for artifacts between game development versus scientific/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 in specific?

Statements:

Our panelists address these issues in their position statements below.

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 (http://www.simcity.com) and the Sims (http://www.thesims.com). It is also possible to find "joyful curiosity" in scientific or information visualization. When we visualize the numerical simulation of fluid flow around an airplane or building, are we not engaging in a certain amount of play? Could it be said that the 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 solve scientific and information problems. One issue is to insure that there is some scientific accuracy in the content of computer games. With all of the 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 the steady progress of advanced rendering techniques. Perhaps there is a symbiotic relationship here!

Peter Doenges:

The 3D computer games boom fuels hardware and software innovation. 3D games are surpassing capabilities of professional 3D graphics and real-time visual simulation. This innovation could benefit sci/info visualization, if the technology reaches beyond little boxes. Sci vis seeks systems knowledge and the value of discovery. Sci vis needs flexible interfaces and visualization programming for basic insights and finding needles in data haystacks. Sci vis also needs accuracy in multivariate data, scalability for lots of data and CPU-graphics bandwidth, and inter-processor communication. 3D games and vis sim focus on human performance under challenge, where the technologies support fast fixed-function rendering of virtual worlds/landscapes for vital human experiences. The march to 3D PCs and consoles could strand sci vis without needed horsepower.

Cross-pollination is attractive, but challenges exist for derivative products to serve sci vis. Recent 3D game hardware turns toward micro-coded pixel shaders, procedural vertex geometry, high micro-polygon densities, animating very large meshes, 2D/3D texture for illumination/reflection, multi-texturing for 1/few-pass pixel pipelines and cascaded separable functions, etc. Developers wonder if PC 3D could scale up in farms of CPUs and 3D boards, if bandwidth relief (low-cost switched fabric?), viable inter-processor software, and good frame buffer access were available. Such graphics clustering needs load balancing in variable rendering to sub-channel frame buffers and synchronization. The time is ripe to stimulate dialog about what might be done to configure "3D in the small" for sci vis, and how sci vis algorithms could adapt to fit new architectures.

Bill Hibbard:

The Internet is taking over the U.S. economy, which means that scientific computing and scientific visualization are a vanishingly small part of the computing world. Thus we can only hope that commercial needs will drive computing in directions that are good for visualization. Fortunately, computer games are doing just that. Soon we'll all be buying our visualization hardware at Toys-R-Us.

My laptop has 80,000 times the memory of my first computer (a PDP-8/S), and runs 50,000 times faster. We will see similar increases in the next 30 years, despite warnings of the end of Moore's law. This means that 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, because games will have the same quality that movie graphics have now. And that means that all today's hard technical problems for visualization will disappear as if by magic. Visualization research will focus on the fun problems, involving visual representations, interaction and collaboration techniques, and abstractions.

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 raise in graphics performance and features in the PC gaming market. Very soon, you will be able to buy a mid-range PC with 1GHz CPU and about a gigapixel fillrate. Recent features of commodity graphics cards include multi-texturing, hardware T&L (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.

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. The gaming industry 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.

Biographical Sketches of Panelists:

Theresa-Marie Rhyne:

Theresa Marie Rhyne is project leader of the ACM SIGGRAPH Outreach to the Computer Games Community. See:(http://www.siggraph.org/geninfo/game_outreach.html#Report) As a result, she is exploring the impact that the computer games community is having on computer graphics and visualization. She is a Lead Scientific Visualization Researcher, employed by Lockheed Martin Technical Services, and is the founding visualization expert of the United States Environmental Protection Agency's Scientific Visualization Center. She was Co-Chair for the IEEE Visualization 98 & 99 Conferences and currently serves on the IEEE Computer Graphics and Applications Editorial Board.

Peter Doenges:

Peter K. Doenges earned BSEE from Rose-Hulman Institute of Technology and MSEE from Syracuse University. He is member of IEEE Computer Society, ACM SIGGRAPH, Tau Beta Pi, NSIA/ADPA, Computer Graphics Pioneers, IMAGE Society Board of Directors, and RHIT Industrial Advisory Board. He represents E&S with the Web3D/VRML Consortium, participates in the OpenGL ARB, and chaired MPEG-4 Synthetic/Natural Hybrid Coding for streaming 3D. Pete has worked 30+ years in real-time visual simulation and 3D computer graphics. He began with GE Electronics Laboratory, Syracuse, NY, in IG R&D, computer film animation for NASA's Shuttle, and real-time hardware/software for Shuttle simulation. He went to GE Daytona Beach, FL, in developing USAF ASUPT scene generators. Pete is V.P. of Strategic Technology at Evans & Sutherland in Salt Lake City, UT. 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.

Bill Hibbard:

William Hibbard is a Scientist at the Space Science and Engineering Center (SSEC) of the University of Wisconsin - Madison. He was the 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. Dr. Hibbard 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:

Hanspeter Pfister is a 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. His research interests include computer graphics, scientific visualization, computer architecture, and VLSI design. Hanspeter Pfister received his Ph.D. 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 1991. He is a member of the ACM, IEEE, the IEEE Computer Society, and the Eurographics Association.

Nate Robins:

Nate Robins works for Acclaim Entertainment. 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. While earning his degree, he worked for Chris Johnson in the Scientific Computing and Imaging group, and got to work on the "Big Iron" (which was tons of fun). He has also been fortunate enough to have worked for Parametric Technology Corporation (PTC), Evans & Sutherland and Silicon Graphics Incorporated (SGI). Nate is probably best known for his efforts in porting the OpenGL Utility Toolkit (GLUT) to the Windows platform. At SIGGRAPH 1998, he lectured in a course about OpenGL and Window System Interaction.