COMMENTS ON SIGGRAPH'91 TOMORROW'S REALITIES

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September 1991

Published in Presence v1, 1992

The 18th International Conference on Computer Graphics and Interactive Techniques, SIGGRAPH'91, featured a juried selection of virtual reality and hypermedia demonstrations entitled Tomorrow's Realities. Conference participants were treated to twenty-six exhibits which represented the state of the art in virtual world techniques. The SIGGRAPH'91 Conference Proceedings (Computer Graphics, July 1991, ACM Press) contains descriptions of each exhibit.

The University of North Carolina, under the leadership of Dr. Fred Brooks, fielded five applications, stealing the show with the cumulative results of a mature research program. The center piece of the UNC exhibit was Pixel Planes 5, a custom parallel graphics engine developed by Dr. Henry Fuchs. Demonstrations included radiation therapy treatment planning, protein molecule fly-through, interactive building walk-through, mountain bike exercise, and a 3D modeler which is the first system that allows the participant to construct models from within an immersive environment. The UNC effort was particularly impressive since it represented the work of a Computer Science Department while the majority of other exhibits were from private companies such as Boeing, Silicon Graphics, SimGraphics, and Division.

Virtual reality, as a field, is pre-taxonomic. In evaluating entries to this event, the jury quickly came to realize that it did not have a single shared perspective on what it was that was being judged. The Jury Chair, Steve Tice, clearly established that, as well as criteria of quality, delivery, and human-factors engineering, the jury had a responsibility to design a curriculum of VR, to present to the public the broad scope of possibilities. Mr. Tice also initiated an essential step, he suggested a taxonomy which could serve to differentiate the apparently different technologies that were submitted as VR applications. This brave step converted an entertaining exhibition into a scientific exercise.

From the conference brochure for Tomorrow's Realities: "Virtual reality (sometimes referred to as artificial reality) is difficult to define. The term has become a catch-all for, among other things, telepresence, artificial or synthetic experiences, and their various delivery systems (head, body, and desktop gear). Because it is an oxymoron, the term itself does not illuminate the nature or importance of the technologies it describes."

Nearly every popular article on this field begins with a litany of names used for VR (artificial reality, cyberspace, virtual worlds, ...). A taxonomy provides the opportunity to differentiate the names. The SIGGRAPH taxonomy includes a concept of Interaction Class:

Desktop/Vehicle: users view 3D worlds through a monitor.
Immersive/Inclusive: users exist and operate "in the picture".
Third-person: users view images of themselves interacting in a virtual world.

Myron Krueger pioneered "third-person" VR under the name "artificial reality". His VIDEODESK teletutoring system and Vivid's Mandala system represented artificial reality at Tomorrow's Realities.

Inclusive VR was most broadly represented, with entries from UNC, the Boeing-University of Washington HITL team (using the VPL system to prototype maintenance and control of a virtual Osprey), Fake Space Labs (showing NASA's virtual wind tunnel), Division from the UK (with a transputer-based parallel VR system), NASA Ames (inclusive sound) and Michael Naimark's class at the San Francisco Art Institute.

Naturally, SIGGRAPH emphasizes visual, 3D display. The NASA inclusive sound system, however, reminds us that VR is multi-sensory. It is difficult to restrict the field to a particular interface bandwidth, the core idea is more that of a feeling of presence. Here the literary community speaks up: presence can be achieved through a good story, through the low-bandwidth of a string of words. In this respect, hypermedia is a form of VR, and the exhibition attempted not to distinguish greatly between the two fields. But as soon as we drop the requirement of high quality immersive display, we must decide if email (and indeed all computer use) is a type of VR.

Mike Naimark's presentations further press the bounds of definition. Film rather than computer graphics defines Naimark's virtual worlds. In EAT, a physical restaurant serves films of food. This is not immersive VR, it is virtuality embedded in the physical world. In Naimark's Moviemap of Karlsruhe, we interact with a branching film of the tramway system as if driving a German tram. In the Portrait One exhibit from the University of Montreal, we interact with a branching videodisc of a pleasant young lady. "The encounter may be cut short because of the visitor's lack of tact, or it may develop into intimate discussions of love in the context of a virtual relationship." Clearly there is another branch of VR which does not depend on interactive graphics. Is a telepresence system which links a participant directly to a robot, without computer graphics mediation, VR? The question is deeper than taxonomy, since blurred concepts can effect even the funding and perceived value of research. To quote Senator Gore during a recent hearing on VR by the Senate Subcommittee on Science, Technology, and Space: "But you have at NASA done a lot of work on what some have called telepresence, sort of the incorporation of virtual reality with robot manipulation. I may be misusing these terms, but that is the way I understand it." As this journal attests, VR and telepresence are sister communities, but the public linkage

may differ from the technical. There were no robotics applications in Tomorrow's Realities.

Personally I rebel when people suggest that Jaron Lanier's term "virtual reality" is oxymoronic. If we are only addressing physical reality, the world of mass, then there is somewhat of an Aristotelian contradiction in the juxtaposition of essence and reality. Reality is, after all, supposed to be everything. However, experience with VR teaches that computational environments, the world of information, are nowhere as exclusionary as physical environments. Dualism and the Pauli exclusion principle do not dictate the virtual. VR is not either-or, it is rather both-and. It is entirely consistent in VR to mix essence with reality; the name "virtual reality" seems to me to capture elegantly the nature of information.

The third category of VR systems at Tomorrow's Realities is desktop or vehicular systems. The concept is one of looking through a window (monitor) into a virtual environment. The vehicle metaphor is appropriate for traditional simulators which surround monitor-based display with a cockpit-like environment. The Battletech Simulator, for example, displays a multi-participant world through a monitor, but each participant sits in a capsule which surrounds that player with controls, lights, and sounds. It is a total experience which includes a graphics view port. All of the multi-participant systems at the exhibition were of the desktop variety. Networked worlds are definitely here, but no exhibitor managed to accumulate enough peripheral devices to present multiple participation using inclusive display techniques.

The monitor based systems generally emphasized a specific input device or system capability. NPSNET, a simulator from the Naval Postgraduate School, presented state-of-the-art interactive simulation for multiple participants using monitors for display. Simgraphics' Assembly Modeler permitted us to interact with a three dimensional environment through the screen of a monitor using a Flying Mouse. The strength of the Assembly Modeler was in its VR development software rather than its display medium. Plasm, from Silicon Graphics, introduced a novel interactive device: participants stood physically on a surfboard which would "hurl their view ports through a vast virtual sky". Here again, the strength was the software which maintained the virtual ecology being explored. Performance Cartoons, from MR FILM, combined graphics with real-time, interactive character animation. The desktop display category was again stretched by this exhibit, since the image was projected on a theatrical display screen. It raised the question of the difference between small monitor and very large screen display.

Perhaps the most novel use of monitor-based VR was Throwing Real Objects into Virtual Space. These production line video games allowed us to hit a real cue ball with a real cue stick. The ball entered a slot below a monitor, which then displayed the image of the cue ball as it collided with other virtual pool balls. The game designer originally believed that simple, geometrically correct modeling of the game space and ball ballistics would yield good results. Players however felt that the ball was not hitting what they aimed

for. The physics of the game was adjusted to conform with the players expectations, resulting in "a smooth and highly intuitive interface with virtually no learning curve." Here we find the fundamental issue for next year's exhibits: the virtual interface is more than new interactive i/o hardware, it is more than new graphics capabilities, it is more than clever software. VR must next face its ultimate challenge, world design to fit human physiology and cognition.