How Do We Solve Human Factors for VR and AR Applications?

Panelists:

Mark A Livingston
Panel Organizer
Naval Research Laboratory

Stephen R Ellis
NASA Ames Research Center

David W Mizell
Cray, Inc

John W Ruffner
DCS Corporation

Mary C Whitton
University of North Carolina
at Chapel Hill

Summary

Virtual reality (VR) and augmented reality (AR) systems are reaching sufficient maturity that some systems are being used on a regular basis by users and others are close to implementation. There are limitations, however, that have prevented many systems from being truly useful for users. An important limitation is the lack of understanding of human factors issues, such as human perceptual and cognitive limitations, that affect the potential utility of VR or AR systems.

Human-computer interaction research has demonstrated that a system with a well-designed interface with few and less powerful features will generally yield better user performance than a poorly-designed interface that is rich in powerful features. User performance depends more heavily on being able to use the features of the software and hardware than on having many complex, but poorly integrated, features. Further, it is difficult to separate whether user performance can be attributed to user interface factors, hardware factors, or other issues.

This observation creates a quandary for VR and AR system designers.

- How do we determine the most important user interface needs and user interface techniques for VR and AR?
- How do we know whether VR or AR methods are better than conventional methods of visualization or information presentation for a given task?

There are many ideas for VR and AR applications, but developing "good" interfaces for them requires a sound understanding of the perceptual and cognitive issues. Until we build and evaluate the application, however, do we really know that VR or AR will be a better tool than current methods (including non-computer methods) or exactly what the nature of the perceptual and cognitive issues are? If so, how do we identify the most important issues and to what extent can we do it? If not, on what basis do we design or choose the applications and proceed?

Some researchers perform only perceptual or cognitive studies. In contrast, some build demonstration applications without digging into the perceptual or cognitive issues. Both approaches have varying degrees of success. Some researchers alternate between task-level and perceptual/cognitive user studies. This raises the issue of integration of results across a class of studies. Is one approach inherently "better" than another? If so, in what sense? Is this really a quandary? If we as researchers really are between a rock and a hard place, then what should we do to solve it?

The panel will debate to what extent this difficulty exists, how it can be mitigated, and the merits of methods proposed to do so.

Biographical Sketches

Mark A Livingston is a research scientist in the 3D Virtual and Mixed Environments Laboratory at the Naval Research Laboratory in Washington, DC. His research interests include human factors for augmented and virtual reality systems, as well as general user interface design for interactive 3D graphics systems. Most recently, he has focused on perceptual issues for mobile augmented reality systems. He received an MS and PhD in Computer Science from the University of North Carolina at Chapel Hill, focusing on user interfaces and tracking techniques for augmented reality systems.

Steven R Ellis heads the Advanced Displays and Spatial Perception Laboratory at the NASA Ames Research Center. He received a PhD in Psychology from McGill University after receiving a AB in Behavioral Science from UC-Berkeley. He has published on the topic of presentation and user interaction with spatial information in 150 journal publications and formal reports. He has been involved in the development and testing of several influential display concepts for spatial displays for aircraft and spacecraft. More recently, he has been involved with the development and evaluation of closed and see-through head-referenced systems for personal simulators and head-mounted information displays, virtual reality and augmented reality displays.

David W Mizell earned his PhD degree in computer science at the University of Southern California in 1977. In 1989, he joined the Boeing Company and worked as a manager in the Boeing "Phantom Works" Mathematics and Computing Technology organization. He was Boeing's lead on several R&D projects in virtual reality, augmented reality, wearable computers, and pervasive computing. While at Boeing, he chaired international conferences on virtual reality and wearable computers, and co-founded and chaired an international conference on augmented reality. Since 2003 he has been employed at Cray, Inc., where he leads the performance modeling and evaluation team for a DARPA-funded project to develop a petaflops-level supercomputer.

John W Ruffner is a Human Factors Engineering Psychologist and a Certified Human Factors Professional with DCS Corporation where he is a Senior Scientist and Technical Advisor for Human Factors and Training. He received a PhD in Industrial/Organizational Psychology and an MS in Experimental Psychology from Iowa State University. He has over 30 years experience in human factors research and development and test and evaluation (RDT&E) for aviation and ground systems. His most recent work concerns the application of augmented reality to air traffic control tower operations. He has published over 100 technical reports, conference papers, and journal articles.

Mary C. Whitton is a Research Associate Professor at the Department of Computer Science, University of North Carolina at Chapel Hill. She has an MS in Guidance and Personnel Services and an MS in Electrical and Computer Engineering, both from North Carolina State University. Her research in virtual and augmented environments gave rise to the following questions driving her current research. Which technical factors influence level of presence and the feeling that the environment "works?" When virtual and augmented environments work, are they worthwhile? She works on teams investigating these questions with respect to scientific telecollaboration, training, and design.