Welcome to the first newsletter. The **VE-SIG** is part of the Human Factors and Ergonomics Society. Membership in the VE-SIG is open to all. To join the VE-SIG send an email to:

mourant@coe.neu.edu

For membership information to join the Human Factors and Ergonomics Society please telephone 310 394-1811 (fax: 310 394-2410).

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**Human Factors in Virtual Environments**

Professor Kay Stanney - University of Central Florida

*ABSTRACT*

This paper reviews several significant human factors issues that could stand in the way of virtual reality realizing its full potential. These issues involve maximizing human performance efficiency in virtual environments, minimizing health and safety issues, and circumventing potential social issues through proactive assessment.

Virtual reality technology will be used to advance many fields, including medicine, education, design, training, and entertainment. The reality is, however, a considerable amount of systematic research must be done before VR technology receives widespread use. If VR systems are to be effective and well received by their users, researchers need to focus significant efforts on addressing a number of human factors issues. This paper provides an overview of many of these human factors issues, including: human performance efficiency in virtual worlds; which is likely influenced by tasks characteristics, user characteristics, human sensory and motor physiology, multi-modal interaction, and the potential need for new design metaphors; health and safety issues, of which cybersickness may pose the most concern; and the social impact of the technology.

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Simulator Sickness

Eugenia M. Kolasinski - U.S. Army Research Institute Simulator Systems Research Unit, Orlando, Florida

ABSTRACT (In Preparation)

Virtual Reality (also known as Virtual Environment or VE) technology shows many promising applications in areas such as training, medicine, architecture, astronomy, data handling, teleoperation, and entertainment. A potential threat to the ultimate usability of this technology is the mild to severe discomfort that some users experience during or after a VE session. Similar effects have been observed with flight and driving simulators. The simulator sickness literature forms a solid background for the study of sickness in virtual environments and many of the findings may be directly applicable. This report reviews literature concerning simulator sickness, motion sickness, and virtual environments. Forty factors, which may be associated with simulator sickness in virtual environments, are identified. These factors form three global categories: subject, simulator, and task. The known and predicted effects of these factors on sickness in VEs are discussed. A table summarizes the information presented in this report. This information can be used as a guide for future research concerning simulator sickness in virtual environments.

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Using Virtual Reality for the Simulation of Infrared Environments for Human Training

A. Brandy Smith - Clemson University

ABSTRACT

A major focus of virtual reality systems is the simulation of environments for human training. It is the purpose of this paper to suggest techniques for extending such virtual environments to include the infrared spectrum. This paper describes methods to dynamically simulate heat transfer and for the generation of infrared images, all in real time. Although there do exist models that produce infrared images of environments these models are generally static and only show one view at one moment in time, usually the time at temperature equilibrium. The model presented in this paper however, is not confined to one view point or moment in time. Instead, a user is immersed within a virtual environment, through the use of a head mounted display, and is presented with a dynamically changing scene that reflects the changing temperatures of the objects as they seek equilibrium within their environment. The view point is also dynamic, allowing the user to move around in the scene observing the changes in temperature from any view point in space. In addition with the use of voice activated menus the user is able to interact and change certain elements in the environment as well. In this way the user is free to turn on or
off lights, motors, and other heat sources and observe the effects that this will have on the other objects in the environment, all of this being done in real time.

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A Toolset for Navigation in Virtual Environments

R.P. Darken and J.L. Sibert - The U.S. Naval Research Laboratory, The George Washington University

ABSTRACT

Maintaining knowledge of current position and orientation is frequently a problem for people in virtual environments. In this paper we present a toolset of techniques based on principles of navigation derived from real world analogs. We include a discussion of human and avian navigation behaviors and show how knowledge about them were used to design our tools. We also summarize an informal study we performed to determine how our tools influenced the subjects' navigation behavior. We conclude that principles extracted from real world navigation aids such as maps can be seen to apply in virtual environments.

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Toron-Nihon Workshop on Interaction with 3D Environments

Shumin Zhai - University of Toronto

SUMMARY

The Ergonomics in Teleoperation and Control (ETC) Laboratory at the University of Toronto's Industrial Engineering Department recently hosted the "Toron-Nihon Workshop on Interaction with 3D Environments". The workshop was conceived by Dr. Paul Milgram, director of the ETC Lab and took place March 16-17, 1995. Sponsorship was provided by the Information Technology Research Centre, Alias Research, and the Defense and Civil Institute of Environmental Medicine. The following presentation were given:

"Force Displays for Virtual Environments"
   Hiroo Iwata - University of Tsukuba, Japan
"Preceptual and Neurophysiological Principles That Should Be Incorporated into Virtual Realities"
   Barrie Frost - Queen's University, Kingston, Ontario, Canada
"Virtual Reality Research at Hirose Laboratory"
   Michitaka Hirose - University of Tokyo, Japan
"Chunking and Phrasing in Human Machine Dialogue"
William Buxton - University of Toronto and Alias Research

"Applying Psychophysical Research in the Design and Use of Stereoscopic Flight Simulators"
David Martin Regan - York University, Toronto, Canada

"3D Interactions in Virtual Space Teleconferencing"
Yoshifumi Kitamura - ATR Communication Systems Research Labs, Kyoto, Japan

"Overview of Haptic Devices at McGill University and the Canadian Space Agency"
Vincent Hayward and Raymond Hui - McGill University and Canadian Space Agency

"An Overview of Research at the University of Toronto ETC Lab"
Paul Milgram - University of Toronto

"Human Factors in 6 DOF Manipulation"
Shumin Zhai, University of Toronto

"Perceptual Issues in Augmented Reality"
David Drascic - University of Toronto

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Simulator Testbed

Dennis Wrightman - Fort Rucker, Alabama, U.S.A.

The Simulator Training Research Advanced Testbed for Aviation (STRATA) at the Army Research Institute Rotary Wing Aviation Research Unit, Fort Rucker, Alabama has time available for organizations (both government and private) and researchers interested in virtual reality or human performance applications research. STRATA is a fully functional flight simulation facility which employs a fiber optic helmet mounted display as a means of presenting the out-the-window view to the pilot. The HMD is capable of presenting a wide variety of display options including stereo and monoscopic, as well as head and eye tracking. It provides a high-resolution display with a 360 degree field of regard. While STRATA is configured as an AH-64 Apache helicopter, the system can be used for any type of task realm customers may desire. Concept formation and testing may be conducted on STRATA for a wide variety of possible applications including helmet mounted displays, avionics displays, or any application where dynamic simulation would be appropriate. The facility is not limited to flight simulation.

TNO Human Factors Research Institute

OUR EXPERTISE TNO Human Factors Research Institute (TNO-TM) has specialized knowledge of human functions. It applies this knowledge in shaping human activities and technical aids. In this way TNO-TM aims to make a contribution to the efficient performance of tasks and to creating optimal working conditions. TNO-TM's
research is of a multidisciplinary nature. Physicists, engineers, psychologists and biologists work together, all using a scientific approach. The focus is on human functioning in a technical environment. TNO-TM employs a staff of 120 and consists of four departments. The department of Perception investigates, for example, object recognition, image quality, 3D vision and 3D sound. The department of Information Processing studies the roles of knowledge, intellect and decisiveness in human information processing (e.g. operators in complex systems). The department of Skilled Behaviour performs functional and psychological task- and training analyses that provide specifications for intelligent support systems. The department of Work Environment is concerned with the interaction between the work environment and human functioning. In particular, perception, navigation and manipulation in virtual work spaces are being investigated. RECENT WORK: 3D SPATIAL LOCALIZATION IN VIRTUAL ENVIRONMENTS TNO-TM has developed a measure for the quality of spatial perception in immersive virtual environment systems. The accuracy of spatial positioning tasks is psychophysically quantified for users of an immersive visually simulated environment: a 5x5 m virtual Ship Control Center of a Dutch Mfrigate. Performance in virtual space was compared with the performance of identical tasks in an identical real environment. The task was to position a hand-held pointer at the imaginary bisection point between two markers in 3D space (separated 2 .. 6 m). Virtual space was simulated using Polhemus' Fastrak head-tracking device, Evans and Sutherland's ESIG 2000 high performance image generator (64 ms delay time) and an Eyegen 3 head-mounted display (color, stereo, 40 degrees field of view). In the virtual space, the averaged distance between indicated and actual bisection points was 35 cm. Dependent on the task, positioning errors in virtual space can be 90% larger than those in real space. These data show that our 3D spatial bisection and positioning tasks are sensitive to the impairment of spatial perception in (high performance) virtual environments due to a decrease of spatial resolution, field of view and/or delayed visual feedback. Experiments in a virtual space with only isolated objects show that subjects spatially integrate environmental detail for optimal positioning performance. Spatial detail appears to be an important property of virtual (and probably of real) environments. It is concluded that the psychophysical tests reported here give a useful quantitative measure of the quality of virtual environments. CURRENT WORK: A VIRTUAL WORKPLACE Current forms of teleworking consist of simple means of communication by either voice (phone, voice mail) or text and graphics (fax, e-mail). The lack of a high degree of interaction may socially isolate colleagues and limits collaboration and coordination. Emerging Virtual Environment techniques potentially solve these problems. Using powerful image and sound generators, 3D display techniques and integrated broadband communication networks, teleworkers can be immersed in a highly interactive virtual work place offering 3D vision of a virtual environment, 3D acoustics, intuitive navigation and manipulation devices. To optimize the level of interaction and to abolish social isolation, ergonomic principles and new interaction methods should be considered in designing an ideal telework place. Further, for successful communication between different companies, communication methods should be standardized. The earning capacity of teleworking will strongly depend on ergonomic design and standardisation that determine the scale of use. TNO-TM is in the process of designing such a generic telework place. A generic telework place combines parts of a real workplace (such as a chair to sit on, a desk to lean on, and perhaps a display for fine graphics and text) with a virtual world that optimally fits individual needs and task requirements. This virtual world contains 3D representations of colleagues, a personal virtual agent to the outer world, virtual archives, multi-media managers, etc. Ongoing technological developments include the merging of real and virtual worlds and the design of multisensory interaction methods. Our human factors studies focus on human performance, navigation, manipulation, communication, skills, and well-being in virtual work places. RECENT PUBLICATIONS Werkhoven P. and Hoekstra W. (1994). Realization of a virtual environment, TNO Report TNO-TM 1994 B-21, TNO-Human Factors Research Institute, Soesterberg, The Netherlands. Werkhoven P. and Kooi F.L. (1994b). 3D Spatial localization in real and virtual environments. TNO Report TNO-TM 1995, TNO-Human Factors Research Institute, Soesterberg, The Netherlands. Werkhoven P. and Veen H.A.H.C. van (1994). Relief recovery from

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Calendar

- May 22-24, Virtual Reality '95, San Jose, CA. Contact MecklerMedia, phone: 800 632-5537
- August 2-4, Virtual Reality and Persons with Disabilities, San Francisco, CA. Contact Center on Disabilities, California State University, Northridge, phone: 818 885-2578
- August 6-11, Siggraph 95, Los Angles, CA. Contact ACM Siggraph, phone 312 321-6830