Applying virtual environments to training and simulation.

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Virtual environment (VE) technology is expected to make a big impact on future training and simulation systems. Direct stimulation of human senses (eyesight, auditory, tactile) and new paradigms for user input will improve the realism of simulations and thereby the effectiveness of training systems. A virtual environment can be defined as a multi-dimensional experience which is totally or partially computer generated and can be accepted as cognitively valid. Based upon this definition, a classification of various types of VE systems can be made. This classification proves helpful in assessing the applicability of VE technology to training and simulation systems.

Two VE training applications were developed at TNO-FEL. One is a prototype system for training target acquisition and firing procedures of the Stinger anti-aircraft missile. This is accomplished by visualizing a terrain database, a model of the Stinger weapon, and models of attacking aircraft in a Helmet Mounted Display (HMD). The aiming and firing sequence is simulated using a 3D mouse as interaction device, mounted on a bare mock-up of the Stinger weapon which provides effective haptic feedback. The simulation of the missile is based on the actual Stinger flight characteristics.

The second application is for training Extra Vehicular Activity (EVA) in a space environment. It provides the participant with an experience of being an astronaut in EVA, moving around the Hermes spacecraft and the Columbus Free Flying laboratory, using a small hand-held thruster as a means of propulsion. The astronaut experiences the way in which firing the thruster affects both translational and rotational velocities of the body. Additionally simple manipulation can be performed, such as the opening and closing of access panels, and retrieval of On-orbit Removable Units (ORUs).

Both VE simulations have been compared with existing training facilities. Conclusions from this are that, in the case of the Stinger simlllator, the flexibility, ease-of-use, transportability and greatly reduced development effort of the VE based system makes it an at least useful addition, and possibly even an alternative to the dome-based system. For the EVA training system, the accurate simulation of the astronaut's motion provided a valuable experience, as did the ability to manipulate storage hatches and ORUs. Shortcomings in both VE simulations are the quality of the HMD (especially noticable in the Stinger simulator) and the lack of tactile feedback (for opening and closing hatches, and manipulating objects in the EVA simulator) .

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Artificial environments are being developed for many purposes, including computer-aided design, telepresence, and visualisation. The approaches to developing these environments vary widely, ranging from realistic simulations for training, to unrealistic "Virtual Reality" for entertainment. Whichever approach is taken, an understanding of the perceptual and cognitive responses of a human participant in the artificial environment will allow a more effective environment to be designed, and technology developments to be driven in the most appropriate directions.

This conference draws together a range of scientific disciplines which can contribute to the development of the visual artificial environment. The sessions are categorised as follows:

Session 1 : Psychophysics In Visual Environments
Session 2: Vision and Display Devices
Session 3: Cues for the Perception of Artificial Environments
Session 4: Perception of 3D
Session 5: Applications of Artificial Environments.

The Geoffrey J. Burton Memorial Lecture will be given by Dr Stephen Ellis, of NASA Ames, USA. This lecture is sponsored by *Virtual Presence.*