# Analysis of the effects of a large-scale stereoscopic display on visual perception

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**Abstract**

The concepts of Virtual Reality (VR) and Virtual Environments (VE) have been introduced as powerful methods for presenting complex three-dimensional scenes. The widely used VR-displays like Workbenches (large-scale horizontal projection plane) and CAVEs™ (secluded room of projection planes) differ mainly from conventional monitors by allowing a stereoscopic visualisation of three-dimensional scenes and facilitating better use of the human perceptive system. But still this three-dimensional visualisation differs from three-dimensional reality, resulting in a different visual perception of the scene and possible constraints for the user.

This paper describes the results of experiments carried out to analyse effects of rendering type on depth perception, limitations of stereoscopic depth perception, and visual after-effects of short-term use of a stereoscopic Workbench display. They were conducted at the Ergonomics and Information Systems Department (EFS) of the FKIE. The experiments were carried out with 27 subjects. The reaction times and errors of subjects when visualising terrain elevation with varying rendering types and 3D scenes were analysed. The results show that the Workbench facilitates the display of stereoscopic scenes within 0.25-0.43 m above and up to 3.5 m underneath the projection surface, depending on the amount of parallax within the scene. Moreover, the use of stereoscopy as main depth cue improves depth perception. Finally, the results of the experiments show that the short-term use of the Workbench (t=30 min) causes no negative effects for visual acuity and binocular visual functions.

## Introduction

Today's computers have become very powerful and complex systems and this development is likely to be intensified in future. Therefore, new paths for innovative human-computer interaction have to be stroked. Virtual Environments (VE) describe such a new kind of human-computer interaction, contributing especially to an enhancement of quality and efficiency of the whole human-machine system. The main goal is to facilitate a natural, sometimes multi-modal presentation and an active exploitation of complex (real or abstract) data. With these systems a widely intuitive use, which is consistent with the user's anticipation, is to be instantiated (Bullinger et

In D. de Waard, K.A. Brookhuis, S.M. Sommer, and W.B. Verwey (2003), *Human Factors in the Age of Virtual Reality* (pp. 93 - 106). Maastricht, the Netherlands: Shaker Publishing.