

Stereovision and dynamic vergence of the eyes: individual differences in visual performance at a three- dimensional display

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Abstract

In virtual reality systems, an object appears in a three-dimensional scene if two displays (viewed with the right and left eye separately) present this object at different horizontal positions relative to the background. If the resulting relative disparity in the retinal images is large, the extra-ocular muscles increase or decrease the vergence angle between the visual axes, i.e. fixation is changed to objects that appear closer or more distant, respectively. Small disparities may stimulate sensory stereoscopic perception of objects behind or in front of the background.

The present study used a three-dimensional display, to present a vergence step stimulus of 0.5 degree in either direction: this amount was fully reached by only a subsample of 28 subjects (within a limited time interval of 300 ms). Similarly, only 10 of 16 subjects had good stereovision in both directions. Physiological origins of these individual differences and implications for vision at three-dimensional displays are discussed.

Introduction

Virtual reality displays have the advantage that objects can be presented in a three-dimensional scene which may be useful for simulation of real working environments. However, a virtual environment can only be used by the observer if the eyes are able to properly extract this three-dimensional information and to operate accordingly. It was the aim of the present study to investigate individual differences in visual functions of binocular vision, i.e. the sensory stereoscopic perception of three-dimensional depth and the adjustment of the vergence angle between the two visual axes by the extraocular muscles of the eyes. It can be expected that reliable individual differences in these visual functions may play a role for eyestrain and task performance when using virtual reality systems. Therefore, these visual functions were tested in four repeated sessions in subjects with normal vision according to clinical criteria.