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Statistical Modeling for Perception of Images in Stereoscopic Displays

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Abstract

Most of the training processes in the stereoscopic displays are performed within the virtual reality environment. Perception analysis of virtual space and operator interaction with the objects being in this space plays a special role when designing and realizing virtual reality systems. The analysis of human factors with further synthesis of the required characteristics will allow providing an optimal way in efficient application of technical capabilities of the complex of virtual reality operational systems and individual operator's peculiarities. In this paper, four main factors were studied to investigate their influence on the degree of efficiency of transfer and perception of information. The four main factors are: resolution, image form, operator's interaction, and control method. A fractional factorial design was utilized to build the experiment. The data was analyzed, and a statistical model explaining the effect(s) of different parameters as well as their interaction, was obtained. It was clear that the 3-D image with high resolution would increase the efficiency of information perception.

Keywords: Virtual reality system; Perception; Fractional factorial design

1. Introduction

There are two main characteristics that differentiate VR system from ordinary systems of computer graphics. First, beside simple transfer of visual information, the system simultaneously acts on several sense organs, namely, hearing, sense of touch, and even sense of smell. Second, VR systems provide direct contact of operator with the medium. The purpose of VR system is to place the participant in the medium which is not only natural, but also easy to study and to get to know. Virtual reality allows enlarging intellectual and communicative operator's abilities due to virtual medium that is generated by knowledge data bases from concrete objects into abstract ones.

The study of virtual reality systems allowed establishing different interaction levels, from limited in certain parameters to entire immersion into VR system. One of VR systems characteristics is preserving interactivity even with large set of data. This characteristic of VR systems provides possibility to interact directly with the real world of data i.e. to use the data sets themselves as objects echo in the cause of interaction

[1-3].

The main features of VR systems at present are considered to be the following; immersion, interactivity, and variability. The availability of these features is necessary and sufficient condition of technological system belonging to VR systems class.

Immersion means that the operator is immersed into virtual reality world, and he percepts himself and objects that he sees as a part of this world. There are three forms of immersion: direct, indirect, and mirror. When the participant feels himself as a part of the virtual world, he sees in the virtual world himself or a part of his body, or he sees the virtual world and himself in the mirror respectively [1].

Interactivity is operator's interaction with the objects of virtual reality world for the realization of functions stipulated by VR system program. Interactivity reveals in the form of: own movement in VR-world, interaction with VR world objects, and reaction (impact) of VR-objects on operator. Significant peculiarity of interactivity in VR-system is real time of its action [4-7].

Variability is necessary for improvement of VR systems efficiency in the sense of changing some values of the parameters that affect the output. Variability condition provides possibility to change features of VR worlds, scenarios, surroundings, game rules and etc., in accordance with the purpose of application of VR-system [8].

Future developments in immersive environments for mission planning include several tools which build up a system for performing and rehearsing missions. This system includes tools for planning long range sorties for highly autonomous rovers, tools for building three-dimensional (3D) models of the terrain being explored, and advanced tools for visualizing telemetry from remote spacecraft and Landers. In addition, Web-based tools for scientific collaboration in planning missions and

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