Researches on sensory display and mutual relation between perception and action

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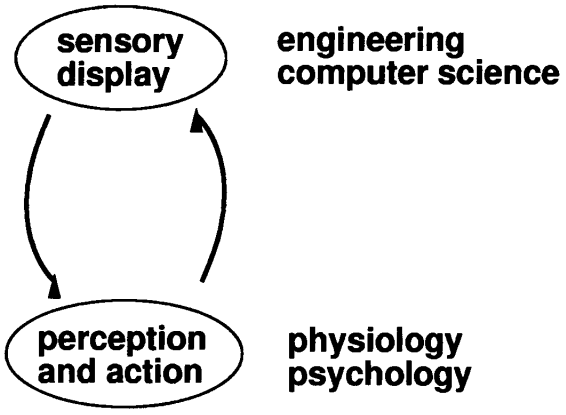
1 Introduction

Visual, auditory, haptic, vestibular, etc. cues are integrated to recognize 3D space in the real world. To make virtual reality system, these sensory displays that give stimuli that is perceived as real are needed. We endeavor to improve sensory displays, especially visual, auditory, and haptic.

Unfortunately, the limitations of both hardware and software make it difficult to represent sensory information faultlessly. Thus, relation between the given cue and human perception has to be explained to improve sensory displays.

The outlines of our researches are given.



2 Human scale virtual environment

We propose a new human scale haptic display for virtual environment with a CAVE like visual display. Tensed strings that make haptic sensation keep the visual environment transparent. Haptic sensations are made to both hands in a large space. Usability of this device is examined.(Makoto Sato)

3 Haptic phantom sensation for interacting with 3D images

Tactile display is important to interact with virtual objects in 3D display. To give pseudo forces representing the forces on operator's hand, we use haptic phantom sensations elicited by two vibrators. They are made in the grip of small tool, to which operator's fingers and hand contact naturally.(Toyohiko Hatada)

4 Development of 5D viewer with visual and haptic feedback

We propose visual and haptic representation of five-dimensional space. Our 5D space is generated by scanning 3D cube. The use's hand can essentially move in 3D space. We therefor use rotational motion of the hand for scanning 3D cube in 5D cube. The 3D cube is cutting volume of the 5D cube. The cutting volume moves by rotational motion around roll and pitch axis of the user's hand. Force display presents potential field which indicates axis of rotation. The user can easily distinguish rotational motion from translational motion by force feedback. Usability of the 5D cube is examined through recognition performance tests and we applied the 5D cube to CT data of human brain.(Hiroo Iwata)

5 Depth perception in binocular stereopsis using liquid-crystal glasses

Perceived depth from subjects' position of 3D actual or virtual objects is measured. The objects presented are chosen among abstract forms, such as sphere, rectangle, and well known concrete goods, such as a tennis ball and a postcard. The virtual objects are modeled and displayed on a CRT screen so that the subjects can view them as 3D objects through liquid crystal shuttered glasses. Subject express the perceived distance verbally and by indicating with index finger.(Takao Kurokawa)

6 Effect of active perception for visuo-motor sensory intrgration

To construct virtual reality systems with multimodal sensory integration, it is important to make clear the function of sensory integration in human. It is indicated that active perception affects the function of sensory integration. In this study, effects of active perception for sensory integration in comparison with effects of active learning and passive learning are investigated.(Masatoshi Ishikawa)

7 Effects of sound localization cue on work efficiency in virtual work space

Sound cue is very significant when visual cue is not available sufficiently in virtual work space. We pay attention to effect of sound cue on work efficiency and examine it in such environment using SPIDAR. We investigate 1. presence of appropriate sound cue raises work efficiency. 2. presence of inappropriate sound cue reduces work efficiency. 3. presence of sound and haptic cue raise work efficiency.(Tetsuya Harada)

8 Tele-handshake interface based on teleoperation with time delay

The concept of teleoperation is used to allow two human operators in different locations to interact with each other by shaking hands. Inside the handshake system, two haptic interfaces are composed of two single degree of freedom linear motion master-slave systems. To couple two operators each other, some required ideal responses for a teleoperator system with time delay are de-

fined. To achieve these ideal responses, we propose a new control approach which is based on the compliant motion technique.(Hideki Hasahimoto)

9 A tele- micro machining system with operational environment transmission under a stereo-SEM

We study a tele-micro machining system which works under a stereo SEM and has operational environment transmission capability. The system includes a three axis force sensing table, the signal from which is converted into auditory information to enhance the operability of the system. The cutting state in micro-cutting is reflected as force feedback to the master joystick using a newly introduced index which represents the cutting state. The cutting force in the micro-world is analyzed and compared with that in macro-world.(Mamoru Mitsuishi)

10 Visual alleys to measure spatial perception in VR space

We study the parallel and distance alleys using binocular stereoscopic images to measure characteristics of spatial perception in virtual reality space. In the virtual reality space, we arrange pairs of marks at different distances. Then we adjust the locations of the marks so that two sets of marks, the left and right marks, look parallel. From the plane coordinates of the adjusted marks, we can observe the perceptual distortion and its characteristics.(Keiichi Abe)

11 Multimedia tele-operation supported by interactive adaptation interface

In recent years communication networks have been developing rapidly. This network enables to realize the long distance communication in real time using sounds, pictures, movies, computer's data, etc. We study a multimedia tele-operation of a crane system by interactive adaptation interface. The proposed system has multimodal display which provides various kinds of information such as force, visual, and auditory one. The interactive adaptation interface can adapt the system to an operator considering his/her skill or knowledge, and psychology.(Toshio Fukuda)

12 Construction of virtual world using dynamics modules and interaction modules

We propose a systematic method of constructing a virtual world by combining dynamics modules and interaction modules, the former denoting elements of the virtual world - virtual objects or operators - and the latter denoting interactions between them. Since this method makes it possible to regard those elements as equal, we can construct a flexible and extendible virtual world to which we can easily add new elements or remove.(Tsuneo Yoshikawa)

13 Motion capture using multiple active cameras

Sensing of human motion is important for human-computer interactive application such as virtual reality, gesture recognition, and communication. Putting special device on human body,

we can get motion easily. However, unrestrained way to get motion is desired. We use multiple active cameras to get best image from best position and get human motion. (Masahiko Yachida)

14 Effects on vision during handling object in VR environment with HMD

This study examines the effects on visual functions of prolonged handling task with the HMD. Both version eye movement and accommodative response is examined. Delayed presentation of display after head movement worsened both visual responses, delay after hand movement does not. It is suggested that decreasing time delay after head movement is more important to improve human performance in handling tasks with HMD.(Tetsuo Kawara)

15 Auditory VR system by multiple point control

We study auditory VR system simplified by wave front synthesis. (Yoshio Yamazaki)

16 Visual depend binding on peripheral vision

We study hand locus during reaching task on VR space, as many VR syetem does not give information to peripheral vision. (Naoyuki Osaka)

17 Communication with VR space by using Speech

Using speech, we can communicate with virtual environment conceptually. (Tatsuya Kawara)