

## 【Grant-in-Aid for Scientific Research (S)】

### Integrated Disciplines (Informatics)



## Title of Project : Systematic Study on Human Response to Noncontact Distributed Haptic Stimulation and Its Applications

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Research Area : Human interface and interaction

Keyword : Haptics, Human-computer interaction, Virtual reality

#### 【Purpose and Background of the Research】

Non-contact midair haptic display using airborne ultrasound can stimulate any positions on a skin at any moment without constraining human motions, in principle, but currently, only small workspaces of applications have been examined as shown in Figure 1. In this study, we first expand the workspace so that the upper half of a human body can move freely in it. Large areas of airborne ultrasound phased arrays (AUPA) are synchronized and precisely control the force distributions on the body while suppressing acoustic stream and avoiding the occlusion problem. Using the developed system, we systematically clarify the human response to haptic stimulation and apply it to 3D interfaces and communication systems.



Figure 1 Aerial touch panel with haptic feedback

#### 【Research Methods】

In order to realize such a large workspace as shown in Figure 2, we first develop AUPA units that are serially connected and can form large areas of AUPA keeping one-microsecond synchronization.

Using this device, we examine a midair 3D interface where we can handle and shape aerial 3D images with tactile feedback. We also realize human motion guidance by noncontact haptic stimulation in midair, which enables efficient interfaces with less load on vision as well as direct instruction of complex motions.

At the same time, we clarify the emotional effects of haptic stimulation by systematically changing the stimulations with visual/auditory ones in various context. The scientific results enabled by the highly repeatable haptic stimulations are applied to the researches of stress control, extension of perceived body ownership and future communication systems.

#### 【Expected Research Achievements and Scientific Significance】

Midair haptics is a new tool to produce haptic sensation with high repeatability and controllability, free from the conventional problems caused from mechanical contact. The research clarifies the nature of haptics and open up a new field of computer interface and interaction.

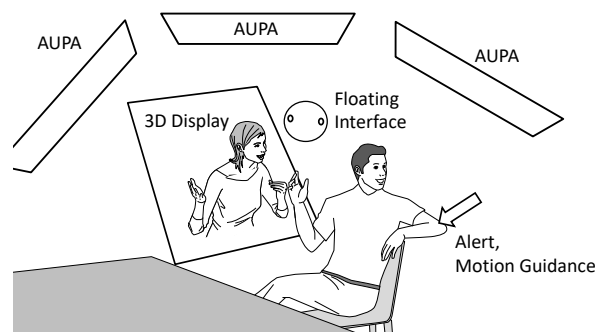


Figure 2 Midair haptics test bench

#### 【Publications Relevant to the Project】

- Y. Monnai, K. Hasegawa, M. Fujiwara, S. Inoue, H. Shinoda, "HaptoMime: Mid-Air Haptic Interactions with a Floating Virtual Screen," Proc. UIST2014, pp.663-667, 2014.
- Y. Makino, Y. Furuyama, S. Inoue, H. Shinoda, "HaptoClone (Haptic-Optical Clone) for Mutual Tele-Environment by Real-time 3D Image Transfer with Midair Force Feedback," Proc. CHI 2016, pp. 1980-1990, 2016.

【Term of Project】 FY2016-2020

【Budget Allocation】 130,700 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<http://www.hapis.k.u-tokyo.ac.jp/?lang=en>