論 文 の 内 容 の 要 旨

論文題目　Remote Cooling Sensation Display by Using Airborne Ultrasound Phased Array
（空中超音波フェーズドアレイによる遠隔冷覚提示）

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Thermal sensation is indispensable to our lives. This sensation responds to temperature change from the outside and enable us to recognize the environment and objects. For example, when we touch the objects whose hardness is the same, the temperature change is different depending on whether it is wood or iron. This difference allows us to determine the material of the target. In addition to audiovisual sensation, a method of displaying tactile sensation has been proposed in VR technology. If it can be displayed thermal sensation in haptic feedback devices, we can experience a more delicate experience.

There has been growing interest in technology for remotely displaying tactile sensation to the skin surface in a non-contact manner in these days, however, the currently realized modality is mainly vibrotactile. The thermal sensation display has been mainly realized by the contact-based method, and few methods presenting heat from a distance, especially to present the cold sensation, have been proposed.

This paper aims to realize remotely displaying a cooling sensation on the skin surface without contacting the device with the user’s body. For that purpose, ultrasound beam or focused ultrasound generated by an ultrasound phased array is used to vaporize the mist floating near the user’s skin surface locally and instantly, and the heat of the vaporization cools the skin surface. The cooling sensation is remotely displayed in a non-contact manner.

In the experiment, firstly, the author demonstrated displaying cooling

sensation by transporting the mist with ultrasound beam. Secondly, the focused ultrasound used for the experiment instead of ultrasound beam. During experiment, we discovered that only the part of exposed to the ultrasound was cooled when a focused ultrasound was irradiated in the mist floating in midair. However, the reason has not been unknown yet. Since this system seems to be sufficiently useful as a haptic display, the author investigated the characteristics in detail and confirmed that it can be used for haptic display.

The result of this study is expected to develop into a more realistic aerial tactile display by applying virtual material feeling such as wood and metal.