論 文 の 内 容 の 要 旨

論文題目　A Study on Tactile Presentation Using Edge Stimulation Method
(境界刺激法による触覚提示の研究)

氏　名　櫻井　達馬

We developed an edge stimulation method that presents sharp and distinct tactile edge sensations using considerably small amplitude of vibrations. This technology achieves low power and strong intensity vibrotactile stimulation and is able to be fabricated in flat surfaces, and these characteristics are suitable for actual applications.

To establish the edge stimulation technology, we investigated the 1.fundamental characteristics of edge stimulation method and the 2.mechanism of enhancement on tactile intensity. For the former, we conducted psychophysical experiments to investigate the performance on tactile intensity and tactile spatial sharpness for several mechanical parameters. The experimental results indicated that edge stimulation method is efficient when the vibrations are in close proximity and the vibration frequencies are low. Also it is demonstrated that edge stimulation method produces more localized vibrotactile sensation compared to a single sharp pin-vibrator used in general vibrotaction. For the latter, the mechanism for these characteristics was investigated by observing spatio-temporal deformation of skin using deformation analysis on finite element finger model. It was revealed that not only strain peak due to strain concentration, but also strain frequency were increased. It is known that the increase in frequency has much larger effect on human vibrotactile sensitivity at lower frequencies than increase in amplitude and the generation of higher frequency in localized spot is a key effect of edge stimulation method.

Our idea for applications of edge stimulation method was to utilize the characteristics of sharp and localized vibrotactile sensations for tactile shape presentation. We developed 1.5 cm × 1.5 cm size 3 × 3 vibrator-array edge stimulation device with piezo-vibrators to present several tactile line patterns. Although we succeeded in rendering 8 tactile shape patterns with the combination of the tactile lines, the further variations of the patterns were limited due to the generation of unexpected lines. To solve this, we have developed selective tactile line control method by phase shift of vibrations. We demonstrated the combinations of tactile patterns of alphabets theatrically.