Quantitative Analysis of Relation among Finger Scanning Speed, Surface Roughness, and Properties of Tactile Receptors *

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I. INTRODUCTION

finger was reported to have correlation with the surface roughness [1][2]. It is reasonable to assume that the scanning speed is either consciously or unconsciously controlled to maximize the tactile perception capacity, which is supposed to depend on the characteristics of the tactile receptors. Each tactile receptor has a frequency band with the highest sensitivity [3]. The vibration frequency generated on the skin is determined by the scanning speed and the surface roughness. In this work, we conducted experiments with tactile samples whose surfaces had microfabricated features and can be quantitatively characterized. We experimentally measured the scanning speed with respect to the surface roughness and deduced the quantitative correlation among the scanning speed, surface roughness, and the properties of the tactile receptors.

II. EXPERIMENTS

(1) The tactile samples used in this study are SU-8 photolithographed on glass substrates and patterned with surface roughness. Six different samples with different widths of grooves were prepared. (0.2 mm, 0.4mm, 0.6mm, 0.8mm, 1.0mm, 1.2mm)

(2) The seated subject was asked to trace freely with the index finger eight times in a horizontal direction with closed eyes.

(3) We captured the finger in free exploratory movements, and the velocity of the finger abdomen was calculated by image analysis using OpenCV.

III. RESULT

The Fig.1 shows convergence of the subject's tracing speed with each successive trial. The Fig.2 shows that the final converged tracing speed for all samples. The frequency was calculated from its convergence tracing speed to determine how many passes through the groove of the tactile sample.

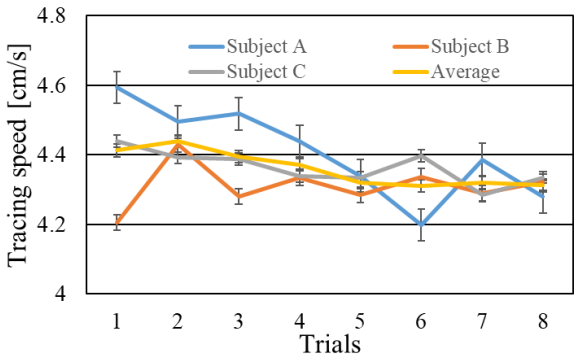

Fig.1 Change in Tracing Speed with Trials (1.2mm)

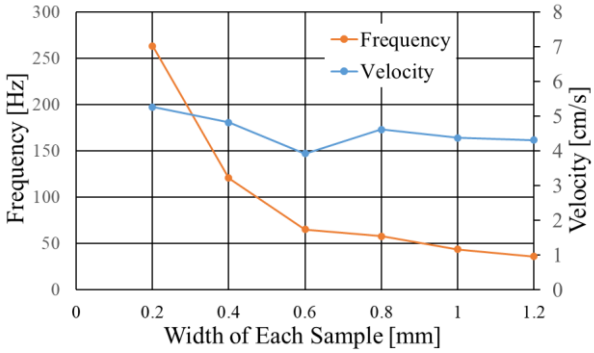

Fig.2 Converge of Frequency and Velocity

IV. DISCUSSION AND CONCLUSION

The experimental results revealed that the velocity was consistent even when the sample patterns are different. This indicates that the kinesthesia awareness, which is one of the deep sensations, may play an important role in investigating the surface. This discovery may pose provide new insights in tactile studies that aim medical applications, such as palpation and remote surgery.

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