

Linkage between Free Exploratory Movements and Tactile Receptor Frequency Responder

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I. INTRODUCTION

In scanning of a surface with a finger, the tracing speed of the 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 depends 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 for the first time.

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. (2 mm, 4mm, 6mm, 8mm, 10mm, 12mm)
- (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 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 per second. The Fig.2 shows how the standard deviation of the tracing speeds with the number of trials. In all samples, the standard deviation became smaller as the number of trials increased.

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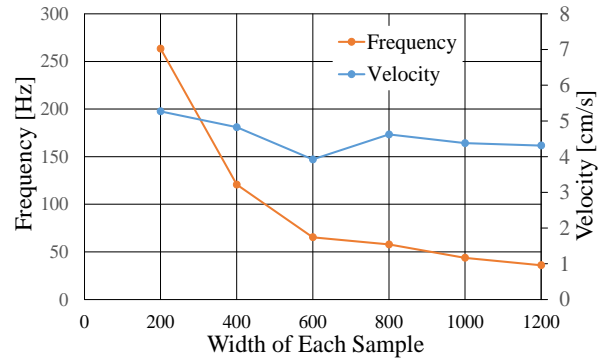


Fig.1 Converge of Frequency and Velocity

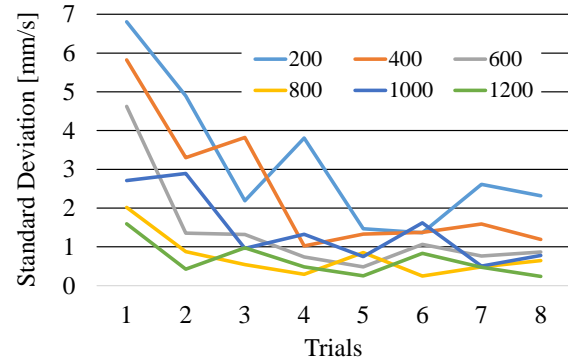


Fig.2 Standard Deviation Changes

IV. DISCUSSION AND CONCLUSION

From these two results, we think that the most sensitive tracing speed exists for each roughness, and that the speeds converged toward that speed. The tactile samples used in this experiment can be categorized as rough (8 mm, 10 mm, 12 mm) or smooth (2 mm, 4 mm, 6 mm). The velocity of tracing changed significantly only at 6 mm, and we hypothesized that there is a threshold of sensitivity for each tactile receptor around this point. We think its frequency is around 150 Hz.

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