A Thesis for the Degree of Ph.D. in Engineering

Hierarchical Modeling of Tactile Sensation based on Human Perception and Augmentation of Thermal Perception using Spatial Summation

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Thesis Abstract

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Thesis Summary

The interest in haptic technology has been growing exponentially in recent years due to its capabilities in accelerating product development cycles especially in analysis and design stage. It is primarily due to the significance in tactile sensations in consumer. By introducing haptic technology in the manufacturing industry, new products can be developed rapidly, thus allowing higher rate of production to satisfy the booming market demand. The integration of haptic technology, namely tactile rendering will be a great aid in product development industries as it can manipulate the prototype’s touch sensation to the chosen material’s touch sensation without producing a sample of the product. Furthermore, to evaluate new products, manufacturers need to conduct a sensory evaluation which is a time consuming and costly process. Therefore, a need to quantify tactile sensation is explored to accelerate the product development.

In this research, we investigate the significance of tactile rendering and sensation technologies in manufacturing industry. For tactile rendering, we focus on the impact of spatial summation for augmentation of thermal sense in AR thermal display. The proposed display is used to replicate the material identification, in order to allow users experience various materials without changing the material of an object. In tactile sensation, we present a novel quantification method of human tactile sense evaluation for fabrics to provide a reliable quality assessment method for textile industry. We hierarchically classify adjectives into three groups called as low-order of tactile sensation (LTS), high-order of tactile sensation (HTS) and desired tactile sensation (DTS). We then perform a multiple regression analysis to discover the correlations between each extracted LTS factor and all measured physical quantities. We express DTS adjectives in terms of physical quantities by computing equations. From the proposed quantification, we are able to predict or evaluate unknown samples’ tactile sensation.