An Unconstrained Tactile Rendering with Tablet Device based on Time-series Haptic Sensing with Bilateral Control

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1. Introduction

In recent years, various tablet devices such as the smartphone and the iPad became used widely. However, user cannot feel the realistic tactile impression when pushing the virtual button key of the tablet device. Therefore, we propose an unconstrained realistic tactile rendering with atablet device, pressure sensors, and vibration speakers based on time-series haptic sensing with bilateral control.

2. Exposition

Recently, various haptic sensors are developed but they are expensive in cost, and there is a difference in performance between these sensors and haptic rendering devices (ex. resolution, maximum measuring force of the haptic sensor, maximum rendering force of the haptic rendering device, etc.). Therefore, we developed a real-time haptic perception parameter (ex. force, stiffness, friction, etc.) estimate method based on bilateral control [Wakita and Tanaka 2013]. In this method, we can obtain 3DOF force data at 1kHz and with low cost. In this work, we measured time-series force data with bilateral control while pushing the touch-pad and several buttons such as the keyboard and the mouse button. To make more realistic haptic data, we made artificial finger and used it in measuring force with bilateral control (see Figure 1). Our artificial finger is composed with bone, tendon, skin with a fingerprint, and nail.

Figure 1. *Haptic Sensing with Bilateral Control*

In bilateral control, we connected between haptic devices virtual spring and damper. Then, we put a touch-pad, keyboard, and mouse in slave side, and we control a grip position in master side automatically. If a slave's grip is contacted to a real object, we capture the time-series force data.

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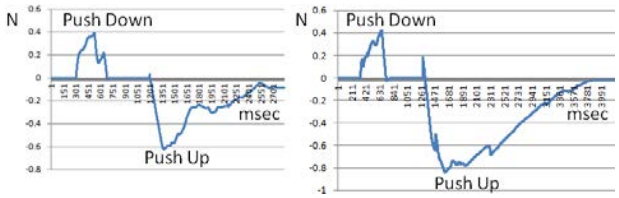
Figure 2 shows difference of contact force of pushing the touch-pad and the keyboard or mouse button.



(a) keyboard (b) mouse button

Figure 2. *Difference of Contact Force of pushing the Touch-pad and the Keyboard or Mouse Button*

3. Unconstrained Tactile Rendering

Figure 3 shows a touch pad with two vibration speakers, four pressure sensors. It is known that human feels pseudo-tactile information by vibration stimuli [Konyo et al. 2005]. Therefore, based on Figure 2, the low frequency wave is generated to vibration speakers according to the state of the push operation (pressure value). As a result, user can feel various push impression such as pushing the keyboard and the mouse button.

Figure 3. *Unconstrained Tactile Rendering*

4. Conclusion and Future Work

We proposed an unconstrained realistic tactile rendering based on time-series haptic sensing with bilateral control. In future work, we plan to represent the shape and friction force of virtual button key.

References

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