Tactile interaction system via 3D images of a hand skeleton

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Abstract. This study describes a method that enables 3D tactile interaction between people at a distance. We constructed a tactile interaction system that presents the sensation of shaking hands on a 3D image of a moving human hand skeleton so that tactile information, which is important in social interaction, can be used in long-distance interaction.

Keywords: 3D interaction, tactile display, tel existence, human interaction

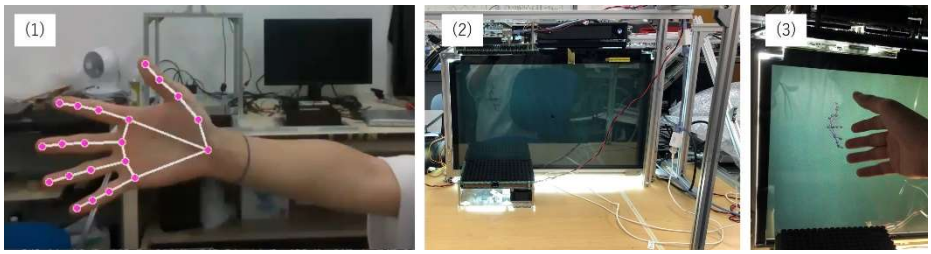

Fig. 1. (1) Result of hand tracking (2) System overview (3) Hand shaking interaction

1 Introduction

In recent years, there have been many studies combining 3D video with tactile sensation [1][2]. We would like to combine these findings to realize haptic interaction via 3D avatars between two parties at a distance. Katila et al [3] argued that haptic interaction had a significant impact on social relationships, and haptic interaction is expected to extend existing online interactions. However, the method of taking images at both remote points and sending video information to be displayed places a heavy burden on communication and reduces real-time performance. Therefore, by extracting and transmitting only the skeletal information of the person, and then reconstructing and moving the avatar in each local environment, it is expected that communication delays will be reduced. In this study, we implemented a system that remotely constructs a 3DCG of a hand skeleton from information obtained by hand tracking

and presents the tactile sensation. This demonstrated the possibility of remote real-time visual-haptic communication.

2 Tactile interaction system

This system is divided into three main parts: transmission of 3D hand tracking data, composition of a 3D image of the hand skeleton from the tracking data, and tactile presentation of the 3D image of the hand skeleton. For hand tracking, the hand is recognized using RealSense and MediaPipe, and the 3D coordinates of 21 points in the hand are acquired. Next, the acquired data is sent to a distant 3D display via TCP communication. The 3D image is composed using the 3D display proposed by Kakeya et al [4]. This 3D display uses the viewer's eye tracking to make the 3D images by using motion parallax. Finally, two AUTDs [5] are placed top and bottom of the 3D display to present ultrasound tactile sensation. The upper AUTD presents tactile sensation at the base of the little finger and the lower one presents at the base of the index finger. When the actual hand is brought close to cover the 3D image of the hand skeleton, the viewer can feel the tactile sensation as if he is holding the hand.

3 Conclusion

In this study, we implemented a system that presents tactile sensations to a remotely configured hand skeleton 3DCG from hand tracking and demonstrated the possibility of remote real-time visual-haptic communication. In the future, it is expected to include the realization of bidirectional interaction and bringing the handshake sensation closer to the actual one.

References

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