Accuracy Comparison of Positional Guidance to Aerial Guiding Illumination Formed with AIRR

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1. Introduction

Most of vein authentications are performed by contacting a hand on a holder. Contacting causes some problems, such as the risk of fingerprint leakage, hygiene problems, and a low throughput. In biometrics authentication of non-contact type, a prototype system that performs vein authentications using images of moving hands has been developed [1] for events and places where a high throughput required. In non-contact vein authentication, it is necessary to guide a user's hand to the imaging position without restriction. We propose an aerial guiding illumination that is formed with aerial imaging by retro-reflection (AIRR) [2]. In this research, we measure and compare the accuracy in the guided hand position on two types of aerial guide illuminations.

2. Principle

The optical system for imaging and illumination proposed in this research consists of a light source, a beam splitter (BS), and a retro-reflector. Fig. 1 shows the principle of our optical system to form aerial guiding illumination for non-contact imaging. The principle of displaying aerial guide illumination is as follows: the light from the light source enters the BS and is divided into transmitted light and reflected light, the reflected light impinges the retro-reflector and is reflected in the opposite direction of the incident direction, and the retro-reflected light converges to the plane-symmetrical position of the light source with respect to the BS to form the aerial image of the light source. This aerial image is used to guide a hand to the shooting position.

3. Experiments

A three-dimensional sensor consisting of an IR camera to verify the accuracy of the guide (LeapMotion: LM-010) was used to measure a hand position. Three subjects conducted 20 positional measurements. Fig. 2 shows the aerial guiding illuminations used for comparison experiments. Fig. 2 (a) is an aerial flat plate guide, which guides the user to place the palm on the surface. Fig. 2 (b) is an aerial "grip" guide, which instructs the user to grip a bar-shaped part of the guide.

The results of the reaching experiments are shown in Fig. 3. XYZ directions are shown in Fig. 2. Note that Y axis shows the vertical position and XZ is the horizontal plane. The origin is the shooting position.

As a result, it can be concluded that the aerial "grip" guide is accurate in guiding the position in the horizontal plane. On the other hand, it is shown that the aerial flat plane guide is able to guide the hand more accurately in the vertical direction.

4. Conclusion

We have measured hand position in the reaching experiments to the aerial guiding illumination is effective in guiding the hand to a specific position in 3D space. It was found that the accuracy of the guided position varied depending on the shape of the aerial guiding illumination.

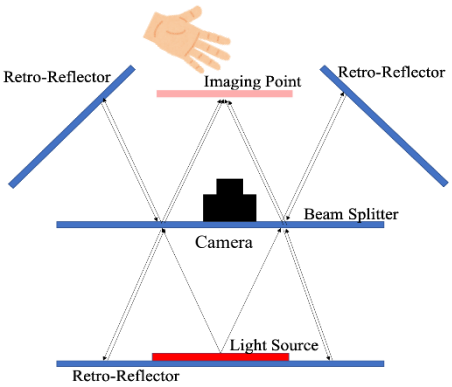

Fig. 1 Aerial guiding illumination formed with AIRR.

(a) Flat panel (b) Handle to be gripped

Fig.2 Aerial guiding illuminations for comparison.

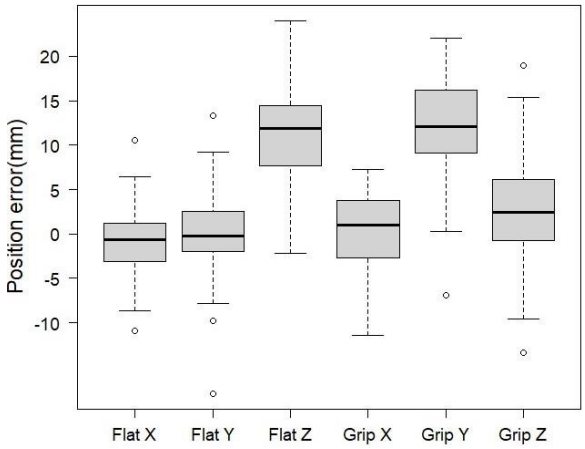

Fig. 3 Positional Accuracy of hand to the aerial guide.

References

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