Clutching Methods for Haptic Interaction System

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Abstract

In this paper, we intend to demonstrate new clutch methods for haptic interactive system. In general, the physical action of clutching (or grasping) enables users to perform several important functions. However, haptic devices have presented users with simple ways of representing this clutching function, such as pushing a button on a mouse or keyboard. Therefore, we proposed new clutching methods which provide users with an infinite-like device space and an intuitive clutch feeling.

1. Introduction and Related Works

Recently, Virtual Reality (VR) technology have been widely used in various fields, such as medicine, education, training, industrial design, internet shopping, etc. In order to construct a VR world which has a more real actual feeling, researches for displaying a haptic sense besides vision and hearing have been done briskly. Since a user can act to an object interactively in the VR world, the haptic sense is very important. Such devices that can present a haptic sense such as SPIDAR-G[1], PHANToM [2], Falcon[3] have been developed, as shown in Fig. 1. Generally, these devises are used for linking the position of the interface device to the pointer in VR world. Position control is intuitive and good for accurate operation, but the limitation of the pointer area represents a major problem [4].

Addressing these problems, some mechanisms have been proposed. A first mechanism is based on a hybrid position/rate control [5], which is useful to interact with a large VR environment. However, it is less intuitive because of rate control. A second mechanism is based on the button clutching. We connected the new clutch system with an on-surface button to a SPIDAR-G system. The on-surface button is added to the proposed clutch system to get inputs from users (Fig. 2). By pushing the button, clutch state toggles between two different states. In this mechanism, users can use position control in a large scale VR environment. However, users have to check device grip position by watching or feeling their arms when they push the button.

Fig. 1 Haptic devices
(SPIDAR-G, PHANToM Omni, Falcon)

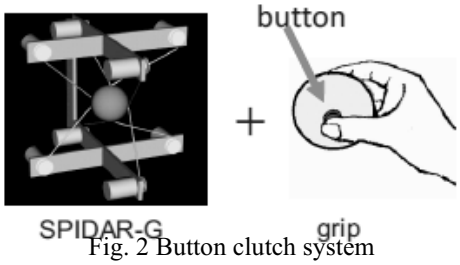

Fig. 2 Button clutch system

In this study, we proposed new clutching methods which provide the users with an infinite-like device space and an intuitive clutch feeling. One of the method is a new grip with clicking and clutching mechanism, and the other one is named "Dual Shell Method".

2. Proposed Methods

2.1. A Grip with Clicking and Clutching Mechanism

The physical action of clutching enables users to perform several important functions including translating, rotating objects. Before doing the tasks mentioned above, we select the objects by clutching it. So far haptic devices have presented users with simple ways of representing this clutching function, such as pushing a button on a mouse or keyboard. We believe that an effective haptic device should be coupled with clutching. The purpose of this study is to realize such a new grip which enables users to clutch an object like manipulating an object in the real world (Fig. 3).

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2.2. Automatic Clutching Method

We proposed a new clutching method named ”Dual Shell Method” which enables the users to intuitively operate a pointer in VR space. It is so named because it is comprised of two shells, with a small shell inside a larger one. Both shells' center positions correspond to the center of the interface device. This system switches clutch state according to grip position of an interface device (Fig. 4). ”Dual Shell Method” is more natural than manual clutching, because clutch state can be switched automatically, so users do not have to keep their attention on the device space.

3. Demo Applications

We intend to demonstrate the following applications using SPIDAR-G (Fig. 5).

- Physics simulation with clutching methods
- Evaluate programs of clutching methods
- Education system
- Puzzle games

Physics-based modeling, which simulates motions of virtual objects based on physics laws, creates realistic motion of virtual objects [6][7]. The combination of these techniques realizes haptic interaction with realistic virtual environments (Fig. 6).

4. Conclusion

In this paper, we proposed new clutching methods. One is a new grip with clicking and clutching mechanism and the other one is called Dual Shell Method (DSM). These methods provide users with an infinite-like device space and an intuitive clutch feeling.

5. References

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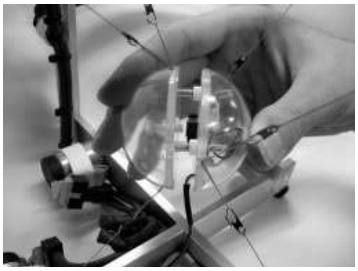

Fig. 3 A grip with clicking and clutching mechanism

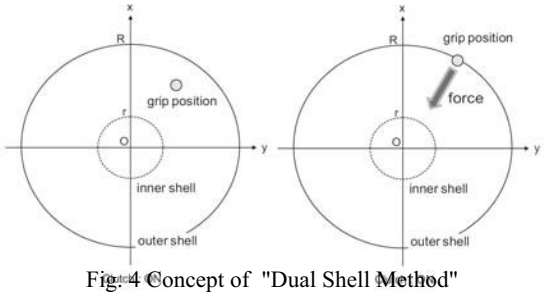

Fig. 4 Concept of "Dual Shell Method"

Fig.5 Demo applications

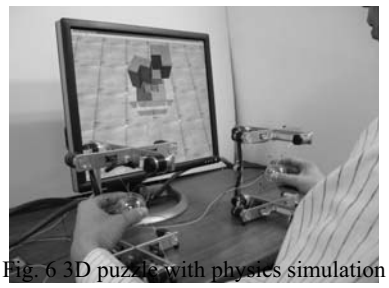

Fig. 6 3D puzzle with physics simulation