Mechanical Design of Multi-Finger Haptic Display Allowing Changes in Contact Location

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Abstract: We present a new type of multi-finger haptic display in which finger contact locations can be changed by a simple mechanism. Our mechanism independently represents the force for thumb, index and middle fingers and contact location changing mechanism. We fabricated experimental units using carbon-fibre reinforced composite material. This haptic display can be used with Spidar to easily expand the area of operation.

Key Words: Haptic displaye, Force represent, Mechanical Design, Human Interface.

1. Introduction

Phantom², Spidar³, Omega are famous haptic displays¹ for representing force at the finger, but they are not suitable to represent force at each finger. To address this issue, HIRO⁴, Cyber force and Spidar 8 were developed, but these systems cannot change the contact location of each finger. Prof. Cutkosky⁵ attempted to change the contact point of the index finger, but the contact location was limited between the top joint and the fingertip. Prof. Yokokohji developed an encountered-type haptic device⁶ for multiple-fingertip contacts, but the mechanism and position sensing were fairly complex.

We, therefore, focused on creating a simpler mechanism for changing the contact location for multi-finger haptic displays. We present here the design of the mechanical apparatus and report on its experimental production.

2. Mechanical Design

Figure 1 shows the mechanical design for changing the contact location of the multi-finger haptic display. This mechanism can represent the force for the thumb, index and middle fingers. The vertical mechanism represents the force and the horizontal mechanism is for changing the contact location. We use a hinge for changing the normal direction of the force, allowing this angle to be changed using a ball screw feed function. This mechanism was fabricated from a carbon fibre reinforced (CFR) composite material. The hand position is sensed and the outer force is controlled by Spidar, implying that our mechanism is supported by eight strings and eight motors. The operating space can be easily expanded, and we achieve 6-DOF control using Spidar.

3. Experimental production

The experimental production was based on the mechanical design of the multi-finger haptic display.

Figure 1. Mechanical design concept.

Figure 2. Force represent mechanism.
4. Conclusion

We have designed a multi-finger haptic display that allows changing of the contact location, and have proceeded with experimental production. We are currently developing the control software for this haptic display and improving its sense of handling.

References