Haptic Video

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1 Introduction

The instruction of professional skills is typically performed with conventional educational materials like video, demonstrating the operations of an expert. There is a multitude of means for knowledge transmission in academic training, but there are relatively few methods to transmit physical skills. Since haptic devices were introduced with the development of VR technology, some instruction systems using force feedback have been proposed. Most systems construct a virtual model of an actual working environment, and present a simulation through computer graphics and a haptic device [Kuroda et al. 2003]. There are also proposed systems that convey skill information to the trainee by recording the movement of the expert, and reproducing it through a haptic device [Yokokohji et al. 1996]. However, instruction is most effective when the haptic sense is proactive. We propose "Haptic Video", a system that records an expert's operations and reproduces them dynamically through haptic devices.

2 Haptic Video

There are two core technical innovation points we implemented to realize active touch [Gibson 1962] through haptic feedback. First, in the recording phase, the position and applied force is recorded while the expert operates. This information is archived in a database that can be dynamically interpolated. In the presentation phase, the impedance information is presented to the trainee along the trajectory direction, and virtual fixtures [Rosenberg 1993], which are like walls with elasticity, are presented orthogonal to the trajectory direction at the same time (fig.1). As a result, the trainee will operate to cancel the force that the expert operated, and exert the desired force proactively. Second, the working environment around the expert's hand is recorded through video from the expert's viewpoint in the recording phase. In the presenting phase, the playing speed of the video is dynamically changed according to location information obtained from proactive operation by the trainee. As a result, the trainee can observe the change of the scenery at the expert's hand as an image corresponding to his own operation (fig.2). In this manner, both vision and tactile information corresponding to an expert's skill can be transmitted proactively, which until now could only be obtained passively (fig.3).

3 Future Works

With the proposed "Haptic Video" system, our goal is to realize a precise and proactive approach to transmit physical skills. By recording the working environment as well as the movement and force of an expert instructor, our goal is to develop an archiving system so that all pertinent skill information can be reproduced dynamically. Another goal of us is to clarify the meaning of proactiveness for the phenomenon of the sense of touch called "active touch", and to verify the effectiveness of the proposed system as a training device. Our ultimate goal is to demonstrate how haptic devices can be used for substantial improvements of existing skills through the recording and proactive reproduction of movement and impedance information of an expert.

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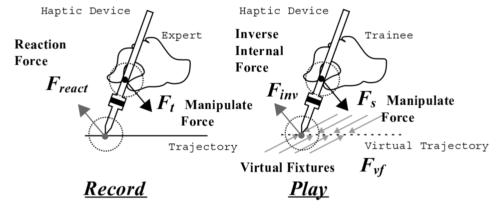

Figure 1: Force Displaying Method

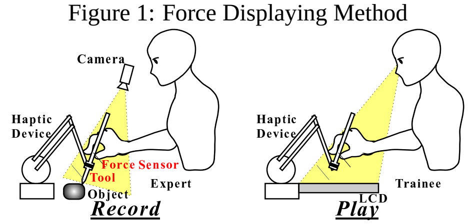

Figure 2: Visual Displaying Method

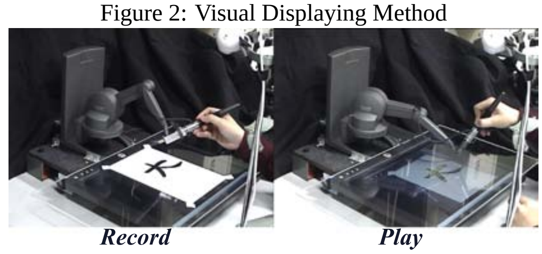

Figure 3: System Overview

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