Haptic Editor

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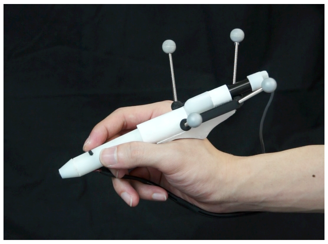

Figure 1: Haptic interface to create and experience 3D haptic content

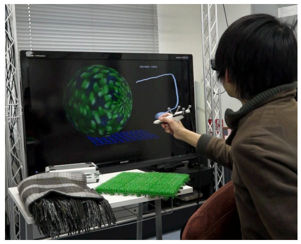

Figure 2: Creation of 3D geometries by aerial sketch

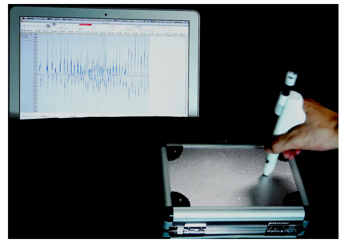

Figure 3: Vibrotactile texture obtained by scanning real object

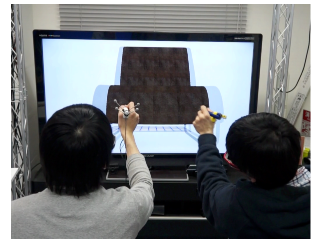

Figure 4: Use of haptic editor for customizable shopping

We propose an interactive editing system for creating haptic-enabled 3D content by drawing shapes in air and copying and pasting surface textures. To realize realistic haptic interaction, we construct the data structure of haptic content composed of kinesthetic layers and a tactile layer. The user can create touchable 3D models by drawing geometries through aerial sketching, setting values of compliance and friction of the geometries, and copying and pasting vibrotactile textures of real objects by using the proposed easy-to-use haptic interface (Figure 1).

1. Introduction

A number of haptic interfaces are proposed thus far. As a next step for the popularity of haptic technologies, a creation system for haptic-enabled content is required. At present, in the market, there are a number of commercially available visual editors for creating and editing images or 3D models. In creation of visual content, it is usual to copy and paste colors or visual textures from one place to another as the eye dropper tool in Photoshop [Adobe Systems, Inc.]. I/O brush [Ryokai et al., 2005] has realized copying and pasting of various visual images from real world to virtual world.

Haptic sensation is an integration of a considerable amount of sensory information, and therefore it is difficult to design haptic-enabled content. In order to realize the construction of realistic haptic content, some research has been conducted on the haptic scanning of real objects as WHaT [Lang and Andrews, 2011]; it enables the user to obtain textures by interactively scanning the objects' surfaces. However, information gained by scanning reveals the minimal bumps of surfaces, and the user cannot directly design and check the sensations of touching the content.

In this project, we propose a data structure of haptic contents for realistic haptic interactions and an editing system for creating haptic-enabled 3D content. To enable the user to design haptic content with the use of various and realistic haptic textures, we realize copying and pasting of haptic textures from real world to virtual world.

2. Method

We have focused on the human haptic perception to generate realistic haptic experiences. Our proposed data structure of haptic content is composed of 4 layers. **Geometry layer** represents geometries of haptic content. **Compliance layer** and f**riction layer** represent distributions of the values of compliance and friction respectively. These three layers are used for rendering of kinesthetic feedback. And **tactile layer** represent a distribution of vibrotactile textures, which is used for rendering of tactile feedback.

We construct a simple and easy-to-use haptic interface for the creation and experience of the haptic content (see Figure 1) by integrating the force-display method we proposed in [Kamuro et al., 2009] and vibrotactile feedback with a voice coil motor. In the proposed haptic editor system, to construct 3D haptic content, the user first draws its geometry by aerial sketching with the device (Figure 2). Shapes are generated based on our sketch-based shape creation method [Kamuro et al., 2011] and displayed with 3D images. During this time, the user can set values of compliance and friction for kinesthetic feedback. Then, the user picks up some real objects and scans their surfaces with the device for copying their texture. A microphone placed at the tip of the device is used for recording the stroking vibrations, which represent the haptic textures of the surface (Figure 3) on the basis of the technology in [Minamizawa et. al., 2012]. The user can now paste the copied textures on the tactile layer. When the user directly touches the content displayed with 3D images, the contact and friction forces are calculated on the basis of the physical simulation and are provided to fingers by translating the grip of the device. Moreover, textural vibrations are provided by the voice coil on the basis of the stroking velocity toward the surfaces. These separated feedback methods result in the realistic sensations of touching textured objects efficiently.

3. Application

Our simple editing system provides an efficient and intuitive development environment for designers of 3D haptic content. They can design the desired content while editing and experiencing the effects of such content by using the simple haptic interface. Further, the users can enjoy creating content with their own hands in their living rooms. Such user-generated-content will serve as a foundation for the popularization of haptic technologies in the future. One possible example of the practical uses of the proposed system is haptic-enabled online shopping. The designers prepare various types of textures that can be used for customizable products. The users sitting in their home can select and test their favorite textures by touching the products virtually via the haptic interface (Figure 4).

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References

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