Monitoring a Realistic Virtual Hand using a Passive Haptic Device to Interact with Virtual Worlds

J.-R. CHARDONNET[1] and J.-C. LEON[2]

[1]Arts et Métiers ParisTech, CNRS, Le2i, Institut Image, 71100 Chalon-sur-Saône, France
[2]Grenoble University, INRIA, Jean Kuntzmann Laboratory, 38041 Grenoble Cedex 9, France
jean-remy.chardonnet@ensam.eu
jean-claude.leon@grenoble-inp.fr

Abstract. We present a prototype of a hands-on immersive peripheral device for controlling a virtual hand with high dexterity. This prototype is as easy as a mouse to use and allows the control of a high number of degrees of freedom (dofs) with tactile feedback. The goals corresponding to design issues, physiological behaviors, include the choice of sensors' technology and their position on the device, low forces exerted while using the device, relevant multi-sensorial feedback, performance of achieved tasks.

Keywords: navigation device, passive haptics, interaction, manipulation.

1. Introduction

Our hands are an essential tool to interact with our environments, for example to manipulate objects. However, interactions may not be easy because for the same object there are generally different possible grasping configurations. This issue still remains a great challenge in virtual reality as current devices, e.g., [1,2], and software do not allow reproducing in a natural and realistic way a grasping motion in virtual environments and they are not devoted to general audience use.

Our proposed solution is based on a passive haptic feedback and a hands-on interaction. We present an extension of the HandNavigator described in [3]. Unlike [1], we conducted validation tests of the existing prototypes on grasping tasks scenarii, to obtain the design of new requirements of the HandNavigator with a more ergonomic shape, sensors improving dexterity and interactions, while integrating tactile feedback for an enhanced immersion.

2. Design of the new prototype

Validation tests on previous versions pointed out several issues that are: the choice of sensors' technology, minimization of muscular efforts and the inclusion of tactile feedback. We designed a new prototype, called V4, where several sensors are used to control each finger: a lever-switch for controlling the virtual finger in a free motion mode, with a low displacement amplitude of a real finger, a vibrator to give the user a tactile feedback when a finger touches a virtual object, and a pressure sensor for controlling the virtual finger in a constrained motion configuration (typically when the user holds a virtual object) and to give the user grasp feelings. All these sensors are integrated in a module depicted in Figure 1. There is one module for each finger, altogether four modules. A spring between the lever-switch and the pressure sensor separates free motion mode and constrained hand motion mode. We added a silicon-based coating on the device as damping material to isolate each finger and prevent vibrations from propagating in the whole structure, so that the user can immediately know which finger touches a virtual object.

We tested our device on a simple scenario where the goal is to position a virtual hand on a part coming from a food processor. A comparison between the real hand configuration and the virtual one achieved using our device is depicted on Figure 2.

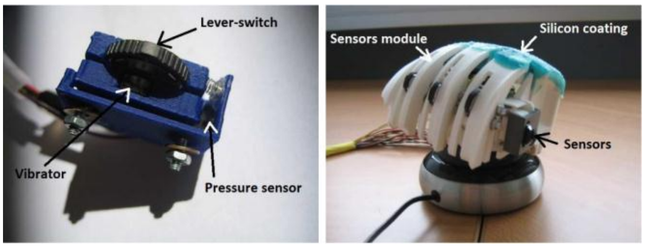

Figure 1. Our new prototype (on the left, a module for one finger)**.**

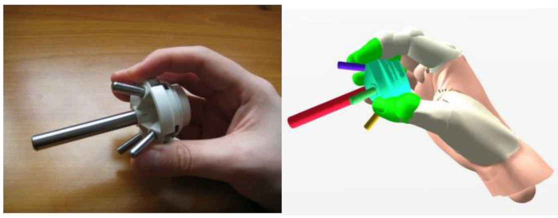

Figure 2. Configuration of a real/virtual hand for object grasping**.**

References

[1] SCHLATTMAN M., KLEIN R.: (2007) Simultaneous 4 gestures 6 dof real-time two-hand tracking without any markers. In ACM symposium on Virtual Reality Software and Technology, pp. 39–42.

[2] BOUZIT M., BURDEA G., POPESCU G., BOIAN R.: (2002) The Rutgers Master II-new design force-feedback glove. IEEE/ASME Transactions on Mechatronics 7, 2.

[3] CHARDONNET J.-R., LÉON J.-C.: (2010) Design of an immersive peripheral for object grasping. In ASME International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC/CIE).