

Iltanen, M., Ellman, A., Laitinen, J.: Wearable haptic device for an IPT system based on pneumatic muscles. Proceedings of 2007 ASME International Design Engineering Technical Conferences IDECT/CIE September 4-7, Las Vegas, USA, 7 p.

Abstract

The human haptic system has an important role to play in human interaction with Virtual Environments (VEs). Unlike the visual and auditory systems, the haptic sense is capable of both sensing and acting on the environment and is an indispensable part of many human activities. In order to provide the realism needed for effective and compelling applications, VEs need to provide inputs to, and mirror the outputs of, the haptic system. These characteristics are the most important issues in the design of confined spaces and mechanical constructions using 6 DOF input devices in Immersive Projection Technology (IPT) or Cave-like systems. Inputs to the haptic system are in the form of haptic displays and outputs are actuator action commands, where the primary input/output variables are displacements and forces.

The idea of total free movement in the IPT system was one of the corner stones of the present study. Therefore the force feedback system should also be wearable. The observer is able to reach objects placed above and below, grip them, and move freely in virtual space. This paper discusses the hardware and software structure of the haptic force feedback system for an IPT system, the theoretical functionality of McKibben actuators and the measured performance of a glove. Force control is based on fast solenoid valves, PID controller and a developed pneumatic muscle model. Muscle actuators are attached to the forearm and control the electronics and valves to a wearable backpack. A developed sensing and force-reflecting exoskeleton applies force to all four fingers and also the thumb. The device has five active DOFs, one for each finger. An ascension motion tracking device is used to track the position and orientation of the forearm. A Fifth Dimensional Technologies fiber optics data glove is used to measure the position of the fingers and provides better information on finger movements. Virtools 4.0 software and VRPN interface was used to connect the data glove, feedback device and PC-cluster.