Institute of FIeld roBOtics (FIBO)

A Cradle of Future Leaders in Robotics

Haptic Interface with Virtual Reality

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Virtual reality (VR) systems have recently promoted attention as a powerful technique that will allow people to experience an imaginary or unreal world without actually building it. The ordinary VR systems allow people to think that they are in the unreal world constructed by computer graphics but they cannot interact with it. The VR system equipped with the haptic rendering ability is a new concept. It allows users not only can see the virtual environment but also can interact with it.

The Haptic Force/Moment Display for Virtual Reality is composed of force/moment interface for displaying realistic sensation and visual interface for displaying virtual scene. In this system, the users will see the virtual objects by LCD planar display or Head-Mount Display, and they will feel like he/she actually manipulating the real objects by holding the robot end effector as shown in figure 1

Haptic Force/Moment Interface. The system is composed of a six-degree-of-freedom robot, a robot controller, a six-degree-of-freedom force/moment sensor and a high performance computer for physically based simulation. The robot will render the realistic feeling to the users by:

1. The force sensor will measure forces and moments exerted my users at the robot end effector.

2. From the force/moment information, the system will calculate appropriate motions that satisfy the virtual object models and sent them to the robot controller.

Visual Interface The system is composed of a CCD camera, a LCD planar display and a computer for creating and displaying virtual screen. By CCD camera at the LCD planar rear, the system will capture the picture composed of user hands and the device (the robot end effector). This picture will be used for estimating the device position
and orientation. The computer graphic will used this device position and orientation to create an appropriate virtual object pose. Because the user hands is still on the screen of LCD display with the virtual objects overlaid on the robot end effector, The users will feel like they see their hands grasping the virtual object through the LCD display.

For example, simulating the virtual cubic box in free space, the users will see the virtual cubic box, created by a computer graphic, through the LCD planar display. Concurrently the users will feel the inertial of the cubic box by holding the device at the robot end effector. Forces/Torques exerted by the users will be measured. The force/torque information will be used to calculate the appropriate motions that satisfy the cubic box physical model. These calculated motions will be sent as the position commands to the robot controller. If the cubic box is 1 kg mass and the applied force is 1 N, the robot will move the device at the acceleration of 1 m/s^2.

The objectives of this research are to build a prototype of haptic force/moment display for virtual reality system and to improve the ability to display the realistic sensation to users.

Figure 1. An overview of a haptic testbed, designed and built at FIBO

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