USC UNIVERSITY OF SOUTHERN CALIFORNIA | IMSC Integrated Media Systems Center

INTEGRATED MEDIA SYSTEMS CENTER
A National Science Foundation
Engineering Research Center at the
UNIVERSITY OF SOUTHERN CALIFORNIA

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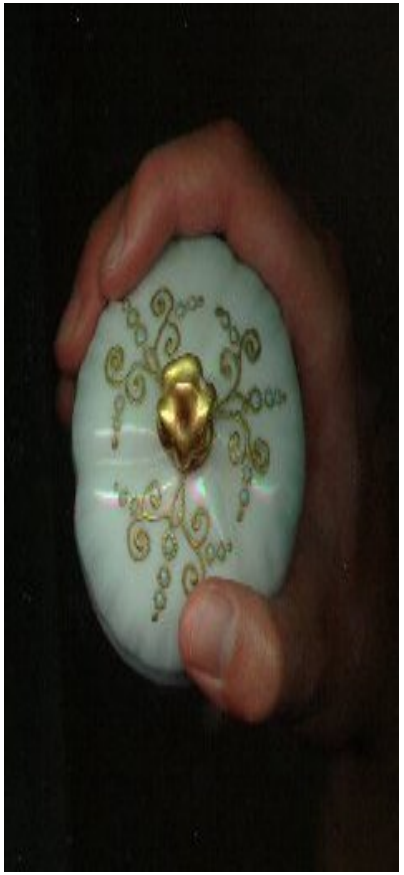
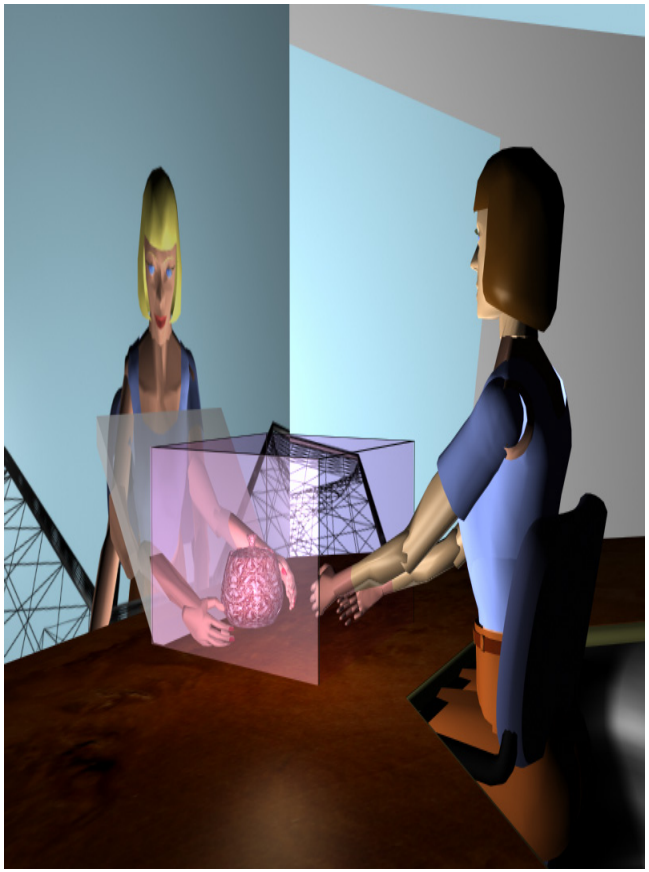
Haptics: HAPTIC MUSEUM





BRIEF DESCRIPTION OF TECHNOLOGY DEMONSTRATIONS

The Haptic Museum demonstration allows a user to “feel” digitized solid models of several art objects, including a group of ornamental picture frames from the Los Angeles County Museum of Natural History, using a PHANToM haptic device. Part of this demonstration involves the use of a virtual mirror, which recreates the sense of looking at a picture with a reflective surface, such as a daguerreotype or tintype. We have also recently designed an exhibition of digital sculptures, and have worked with artist Deborah Aschheim to create a room-size light installation whose actions are controlled through a haptic interface as well as hands-on human touch. Currently we are also able to demonstrate mutual touch over the Internet with hetereogeneous haptic devices, which in the future will allow museum patrons and museum staff to jointly explore the shapes and surfaces of museum objects. We are also currently demonstrating a prototype of an information system for the blind and visually impaired, which integrates haptics and speech recognition.

UNIQUE OR DISTINGUISHING CHARACTERISTICS RELATIVE TO STATE-OF-THE-ART

In collaboration with our colleagues at USC's accredited art museum, the Fisher Gallery, our IMSC team is developing an application that will not only permit museum visitors to examine and manipulate digitized three-dimensional art objects visually, but will also allow visitors to interact remotely, in real time, with museum staff members to engage in joint *tactile* exploration of the works of art. Our work on distributed haptics is the only application to focus on hetereogenous haptic devices. Our work on scientific visualization for the blind is unique in its combination of human factors emphasis, integration of haptics and speech recognition, and physically-based haptic rendering of seismic data.

APPLICATIONS

Although haptics is a relatively new area of research, applications have been in the areas of **visualization**, **telemedicine** and **surgical training**, and **alternative input devices for the visually impaired**. There are clear potential areas of application in **assembly and manufacturing**. Targets are industries with a need to visualize information or train workers in assembly, especially to improve operator performance in difficult tasks by creating virtual fixtures that are overlaid on the real objects. The project has near-term applications to **museum exhibition practice** as well.

RECENT HIGHLIGHTS, LEVEL OF DEVELOPMENT, UPCOMING MILESTONES

Recent highlights include the semi-automated digitization of art objects using stereo vision, the development of Kalman filter based tracking algorithms, the acquisition and installation of the CyberGrasp system and the development of an initial design for the structured data which will code effectively for a variety of haptic information, and the simultaneous use of the PHANToM and CyberGrasp for experiencing haptic feedback from a shared object. In the coming year we hope to extend our work into the area of medical simulation, including projects on arterial catheter insertion and rehabilitation for recovering stroke patients.

UNDERLYING TECHNOLOGIES

- **Haptic acquisition and display** is analogous to capturing and displaying images in the visual world. In the haptic domain this consists of digitizing objects so that the digital virtual object “feels” like the original much as a good image look like the original. Haptic display is concerned with the generation and application of appropriate forces and torques to the user via a haptic feedback device such as the CyberGrasp.
- **Hand tracking** is concerned with the development of algorithms for real-time low error estimation of the position and orientation of the user's hand.
- **Real time image analysis and computing** is the software support for the haptic display and hand tracking.
- **3D graphics** are needed for the visual display that will accompany the haptic display as well as for the stereo-based digitization of the objects of interest.
- **Storage and retrieval of immersidata** is required for accessing virtual geometries efficiently and for the archival of haptic user traces for content based retrieval and analysis.
- **Speech recognition** is concerned with natural dialog systems for interacting with computers through spoken language. As part of our effort to meet the needs of visually impaired users, all of our exhibitions feature a spoken dialog system for interacting with the exhibition, including the ability to control some of the movements of the PHANToM haptic device through spoken commands.

LIST OF PUBLICATIONS, REFERENCES, URLs

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The Haptics Lab Web site: http://imsc.usc.edu/haptics

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