



INTEGRATED MEDIA SYSTEMS CENTER

A National Science Foundation
Engineering Research Center at the
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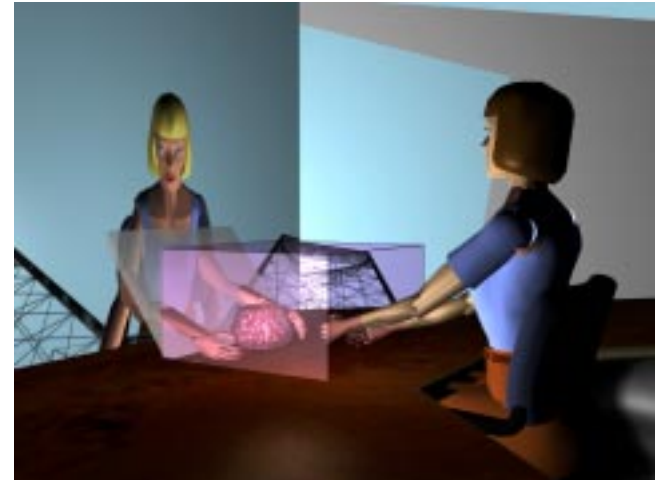
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HAPTIC MUSEUM



USC STUDENTS, DEGREES

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BRIEF DESCRIPTION OF DEMONSTRATION

The current Haptic Museum demonstration allows a user to “feel” digitized solid models of several objects, including teapots, using a PHANToM haptic device. The user can manipulate the orientation of the object in real time, sense contact with the object, and feel its surface. Currently we are also able to demonstrate mutual touch over the Internet with heterogeneous haptic devices. We are also currently demonstrating a prototype of a seismic 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 heterogeneous 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 breast tumor palpation and minimally invasive surgery.

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.

LIST OF PUBLICATIONS, REFERENCES, URLs

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- Schertz, P. M., J. Jaskowiak and M. L. McLaughlin, "Evaluation of an Interactive Art Museum," SPECTRA, A Publication of the Museum Computer Network, 25 (1), 33-37 (1997).
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The online version of the Haptic Museum: <http://digimuse.usc.edu/haptics.htm>

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