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TUTORIAL – 06

Virtual Reality in Computer Haptics

SI. NO	Speakers	Topic	Qualification/Area of interest.
1	Dr. D. L. Prabhakar, Professor, Incharge of CADS, MCE, Hassan.	Reality-based models & Computational techniques.	Ph. D, Published 20 papers in Journals/conferencences in the area of FEM (offline). Now, working on FE simulations (on-line) for haptic applications.
2	G.M. Lingaraju, Sr.Lecturer, CS&E, JNNCE, Shimoga.	Introduction, concepts, and over all system design. Presentation through video clippings, Future direction.	M.Tech (CADS), Doctoral candidate in the area of VR in Computer Haptics. Guiding M.Tech (CS&E) projects in the area of haptics.
3	Sandeep C Senan. . & Vamsi Mohan T	Design details of cost effective devices, Virtual sense of touch.	B.E (CS&E), students

DURATION: 2 Hrs

Organization of the tutorial:

1: Introduction to haptic technology: Touching a virtual object for the first time can provoke surprise, wonder, delight, even a bit of fear. Not unlike the first time you see a magic trick, this touch startles you because of the sudden appearance of something physical, apparently from nothing. But touching a virtual object requires a specialized display system, or 'haptic interface' to transmit forces back to our hand or finger in a way that mimics the sensation of touching real objects. These surfaces let you feel objects created by the computer, much as a graphic display lets you see computer-generated objects.

2: Review of Literature related to haptics, even from Weber and involved companies/ universities working on haptic technology. Overview of Tactile devices 1). CyberTouch, 2). Touch Master, 3). Tactool System, 4). Displaced Temperature Sensing System and

Force Feedback devices 1). The PHANTOM, 2). The FEELit mouse / Wingman Force Feedback mouse. 3). penCAT/Pro, 4). The moose, 5). The Virtual Reality mouse, 6). Force Feedback Joystick, 7). Cybergrasp, and 8) Sacros Arm.

3: Brief review of commercially available interfaces like Armlib, GHOST, etc. Including overall scheme of the integration of devices to the system.

4: Mathematical modeling and optimization techniques required as a numerical tool for the problems of mechanics. Here the target problems may be formulated and descritized by the Finite Element Method, resulting in a large system of simultaneous ordinary differential equations. By integrating the equations through time, the design model simulates the dynamics at each time step .The concept of force feedback will be covered.

5:Real-time responses of the systems are discussed for the critical lag component of the Finite Element Simulation using software tools such as OpenMosix .

6: Shared memory which is used for communication channel between visual feedback process and force feedback processes and the overall organization is presented.

7: Haptic rendering is fairly new field, and thus object models have primarily been simple geometry's such as planes (combined to form polyhedrons), cylinders, spheres, and other basic shapes. The most basic and commonly used haptic rendering algorithm is to model the virtual environment as intersecting planes, and provides force normal to the plane proportional to penetration (stiffness) and force tangential to the plane proportional to velocity (damping). However, this simple proposal fails in several ways: curved objects do not feel smooth because they are modeled with facets, on a non-convex object there is ambiguity in determining which plane penetration should be used to generate the force, collision detection in an environment with many planes may not be executed in real time, and objects lack the realism of surface texture and friction. In the last few years, more sophisticated haptic rendering has been developed to deal with these problems. One way to categorize the work in this field is by solving the problem associated with general rendering, geometrical modeling, and surface properties.

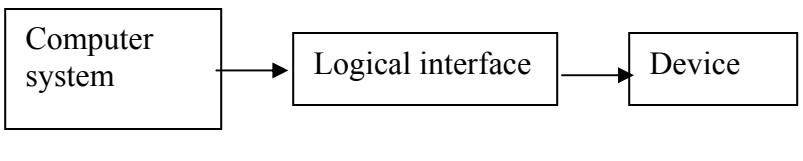
8: To animate something is, literally, to bring it to life. Animation covers all changes that have a visual effect. Visual effects can be of different nature. They might include time-varying positions (motion dynamics), shape, color, transparency, structure and texture of an object (update dynamics), and changes in lighting, camera position, orientation and focus. The extension of constraint-based animation system to support a hierarchy of constraints and to provide motion where constraints are specified by the dynamics of physical bodies and structural characteristics of material is a subject of above research. To display the scientific visualization with which we are creating deformed object by touching through haptic interfaces can be displayed using OpenGL (as an API)

9: VIRTUAL SENSE OF TOUCH

Human nervous system is one of the complicated & sophisticated systems in the world. It produces a minute amount of electric analog signals, which are in terms of micro and nano volts. It produces different frequencies, which is recognized by the brain's sensing cells.

So, inorder to achieve this in virtual reality, we have to produce that particular range of voltages and frequencies which brings the same texturity and structures of the real objects. As we know human body is neutral body, a sense of touch produces a potential difference, which is grabbed by the brain cells via nervous system and produces a sense of touch.

Computer is a digital system. It can produces only digital signals, which are of rectangular wave format. Thus we require an interface, which converts digital signals to analog signals. These produced analog signals must be in terms of micro or nano volts. This interface is then connected to the device, which vibrates to the particular frequency and produces a particular voltage.



An abstract view of the virtual sense of touch machine.

10: Design and implementation of cost effective haptic devices ,e-smell device,and other position recognition system for virtual environment .

Conclusion

In the tutorial session review of literature related to haptics, Companies/Universities working on haptic technology along with overview of haptic devices/interfaces, system architecture and other related research components will be discussed. Presentation through video clippings as well as live demonstration to have a sensation of touch , is proposed.

Future Direction

The concept of handshaking in video conference and virtual touch in immersive environment as well as immersive walk, through a robot. Will be discussed.

Acknowledgement

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