

The role of Haptics in engineering and medicine

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Haptics refers to sensing and manipulation through touch. The definition of haptics includes all aspects of information acquisition and object manipulation through touch by humans, machines, or a combination of the two; and the environments can be real, virtual or teleoperated. This is the sense in which substantial research and development in haptics is being pursued around the world today.

This talk will start with the three main sub areas of haptics;

1. human haptics - the study of human sensing and manipulation through touch,
2. machine haptics - the design, construction, and use of machines to replace or augment human touch.
3. computer haptics - algorithms and software associated with generating and rendering the touch and feel of virtual objects (analogous to computer graphics).

Consequently, multiple disciplines such as biomechanics, neuroscience, psychophysics, robot Design and control, mathematical modeling and simulation, and software engineering converge to support haptics.

The talk will also introduce the current research work of haptics in medicine area, specifically medical simulation. Just as flight simulators are used to train pilots, the multimodal virtual environment system we have developed is being used in developing virtual reality based needle procedures and surgical simulators that enable a medical trainee to see, touch, and manipulate realistic models of biological tissues and organs. The work involves the development of both instrumented hardware and software algorithms for real-time displays. An epidural injection simulator has already been tested by residents and experts in two hospitals. A minimally invasive surgery simulator is also being developed and includes (a) in vivo measurement of the mechanical properties tissues and organs, (b) development of a variety of real-time algorithms for the computation of tool-tissue force interactions and organ deformations, and (c) verification of the training effectiveness of the simulator.

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Education:

Ph.D. in Mechanical Engineering, Massachusetts Institute of Technology (2003)

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Experience:

2003-2004: Senior Research Engineer, Haptic Technologies Inc (Cambridge, MA)

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