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IDM@NTU

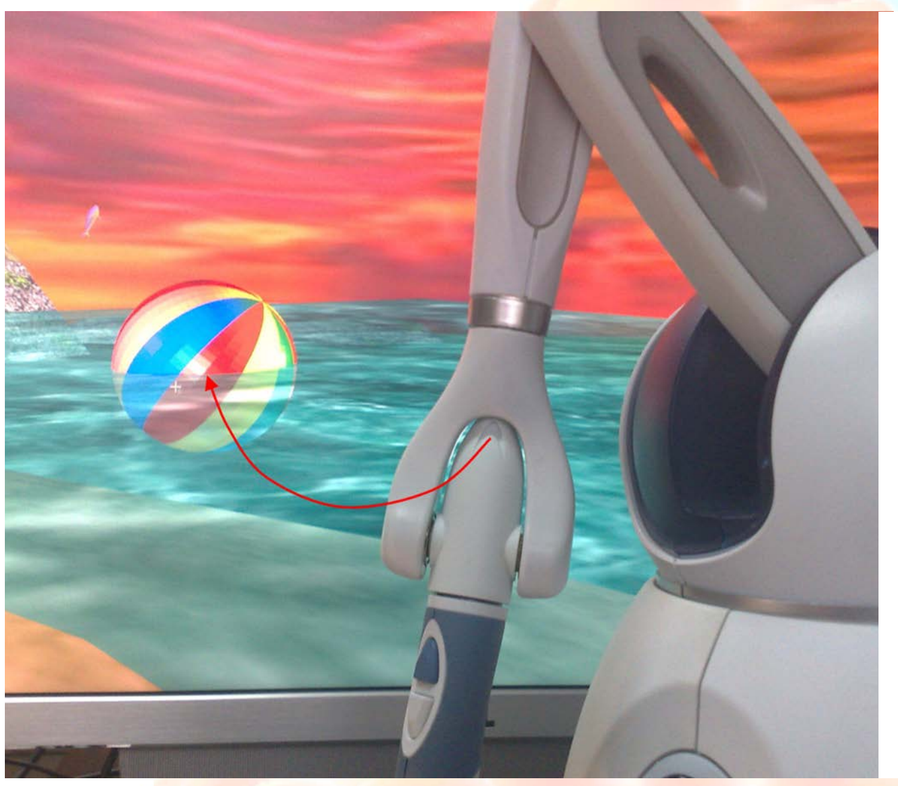

Figure 1

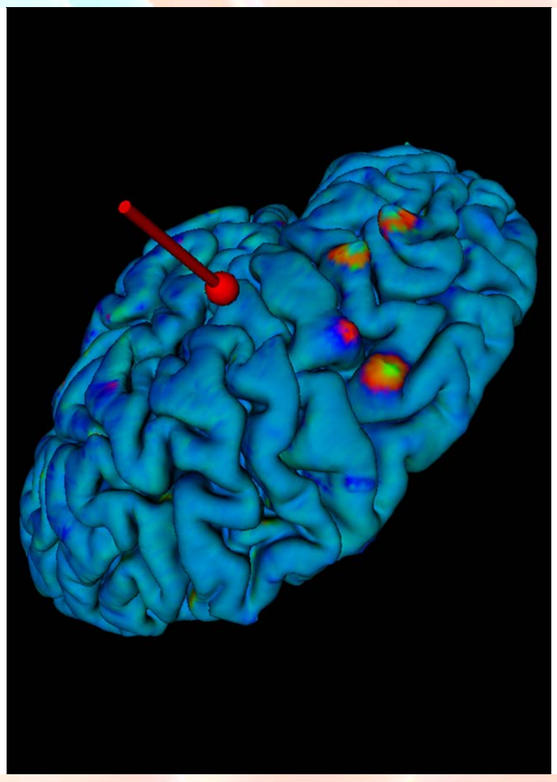

Figure 2

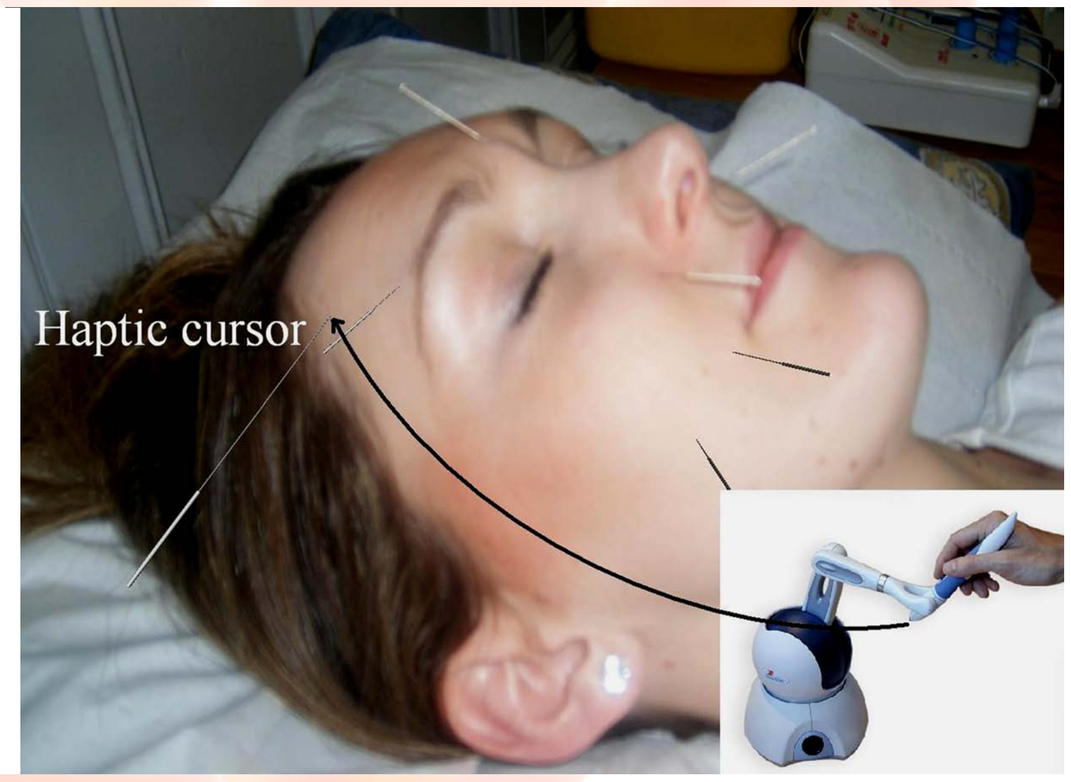

Figure 3

VIRTUAL TOUCH

HAPTIC INTERACTION IN SHARED VIRTUAL SPACES

Polygon based models dominate in virtual reality. These models also affect haptic rendering algorithms which are often based on collision with polygons. Therefore the number of polygons restricts the precision of haptic interaction. In contrast to this approach, we use mathematical functions to define various tangible physical properties (elasticity, friction, viscosity, and force fields) as well as geometry (curves, surfaces and solid objects), and visual appearance (3D colors and geometric textures) of the virtual objects. The function definitions are given as analytical formulas, function scripts and algorithmic procedures. Since the defining functions are very small, we can efficiently use them in collaborative virtual environments to exchange between the participating clients. The function-defined objects and parts constituting them can be used together with other common definitions of virtual objects such as polygon meshes, point sets, voxel volumes, etc. We implemented a function-based extension of X3D and VRML which allows for defining complex geometry, appearance and haptic effects in virtual scenes by functions and common polygon-based models, with various object sizes, mutual penetrations, variable precision, and arbitrary location of the observer.

Figure 1: A common VRML scene made tangible by augmenting it with function-based definitions of physical properties

Figure 2: Polygon-based visual rendering is mixed with implicit function-based haptic interaction

Figure 3: Virtual acupuncture training: image driven 3D haptic interaction

CONTACT:

Assoc Prof Dr Alexei Sourin <alexei.sourin@fraunhofer.sg | assourin@ntu.edu.sg>

IN COLLABORATION WITH:

NANYANG TECHNOLOGICAL UNIVERSITY

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