Haptic accuracy in a Virtual Reality arthroscopy simulator

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WISHKATS is a virtual reality-training simulator being developed for knee arthroscopy. The necessary fidelity of such a simulator is determined by complex interrelated factors including: task and skill requirements, experience of the user, capabilities of the human perceptual system, and user acceptance. This paper describes a Human Factors approach including consideration of theory, fieldwork and novel experimental work to describe 'optimised fidelity' with a focus on the production of innovative haptic feedback. Typically, haptics generation is constrained by device design and performance. WISHKATS design is being mediated by research to determine the necessary accuracy of a haptic device in terms of human perception. Fidelity will be tuned to the sensitivity of the human cognitive system for specific task performance.

Introduction

The WISHKATS (Warwick, Imperial, Sheffield Haptic Knee Arthroscopy Training System) simulator is being designed to train the arthroscopic diagnosis of the knee. The focus of the project is the incorporation of innovative haptic feedback and deformable tissue models into a Virtual Reality (VR) simulation. This paper details the human factors approach being adopted in the project to consider the issue of appropriate simulator fidelity. The theoretical and methodological approach to the examination of haptic fidelity is discussed.

Virtual Reality for surgery

VR has been applied to simulator development for a range of operative techniques including suturing (O'Toole et al., 1999) endoscopic sinus surgery (Weghorst, 1998), and laparoscopy (Tendick et al., 2000). The recent growth in VR training has emerged from technical developments both in simulation and in surgery, and especially the proliferation of Minimal Access Surgery (MAS). MAS offers the patient improved recovery times, reduced scarring and exposure to infection, however significant risks are posed to the patient from surgical error during the learning process.

During MAS the operative site is viewed using a camera and operated upon using lengthened tools inserted into the field via small holes or portals. The image is

In D. de Waard, K.A. Brookhuis, S.M. Sommer, and W.B. Verwey (2003), *Human Factors in the Age of Virtual Reality* (pp. 45 - 62). Maastricht, the Netherlands: Shaker Publishing.