Principles and Applications of Medical Virtual Environments

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Overview of Paper

**History of Medical Imaging**
Endoscopy, X ray and X ray tomography, Ultrasound, Nuclear Magnetic Resonance Imaging (MRI)

**Software Algorithms**
Segmentation, Surface rendering, Volume rendering, Soft tissue modelling

**Virtual Environments**
Haptics, Telerobotic systems, Spatial tracking, Remote visualisation

**Applications and Innovations**
Educational Tools, Radiotherapy, Guide Aid, Neurosurgery, Augmented Reality, Nanotechnology
Current State of the Art

This Medical Virtual Environments Paper was written in 2004

Immersive Open Surgery Simulation (CAVE).
University of Reading 2006

Medical Image Segmentation using Immersive Visualisation.
MSc Thesis University of Hull 2006
Algorithms

Segmentation
- identify parts of the anatomy

Surface rendering
- approximations of surface from volume data
- polygonal mesh

Volume slicing
- visualising a volume by a series of slices

Volume rendering
- voxel based data
- voxel assigned a colour and opacity value

Soft tissue modelling
- geometrically based (shape of an object)
- physically based (material property)
Virtual Environments I

**Haptics**
- sense of touch
- skin curvature and stretch
- temperature
- minimally invasive technology

**Telerobotic Systems**
- exoskeletons
- gloves and wearable devices

**Spatial Tracking**
- wands, hands, tools
- position of users eyes
- magnetic, optical, acoustic, inertial, mechanical hardware
Virtual Environments II

Visual Displays
- desktop displays (bone drilling software)
- reality room configuration
- autostereoscopic displays (and possibly even holographic)

General Input Devices
- fully immersive VE
- data glove grabbing objects

Remote visualisation
- visualisation server
- streams contents across network
Applications I

Educational Tools
- teaching of human anatomy

Diagnostic Aid
- surgeon sees internal structure

Virtual Endoscopy
- visualisation of internal structure
- record trajectory path through organ

Radiotherapy treatment planning
- virtual radiotherapy room

Guide aid
- high resolution miniature camera
- image guided surgery
Applications II

Neurosurgery
- MR and CT images to IT system
- virtual instruments trajectory
- tumour tissue

Augmented reality
- augmented into surgeons view
- planning surgery

Robotics
- microscopic and endoscopic surgery
- neurosurgery, orthopaedics, cardiac surgery

Nanotechnology
- molecular level (nanorobots and microsubmarines in bloodstream)
Assessment of the Paper

Sometimes difficult to read – too wordy and too long

Does not contribute very much to research - more of a report

Conclusions are a bit short

Latest Review written – still valid as a General Reference

Very Thorough Review of Medical Virtual Environment Systems

Virtual Environments Review is very good and not too technical

Medical descriptions are not too technical

Covers all the applications and training benefits to clinicians