Developing a Virtual Environment for Training in Visceral Interventional Radiology

Presenter: Dr Franck P. Vidal

Main Project Collaborators: Dr P.F. Villard, Dr R. Holbrey, Mr J. Zhai, Dr K. Karuppasamy, Dr S. Pisharody, Dr Y. Zhang

This work presents independent research commissioned by the National Institute for Health Research (NIHR). The views expressed in this publication are those of the authors and not necessarily those of the NHS, the NIHR or the Department of Health.



Introduction

- Context
 - Interventional Radiology
- Problematic
 - Basic skills are taught in an apprenticeship in patients
- Solution
 - High fidelity simulations using VE.
- Challenge
 - IR procedures are more reliant on the sense of touch than other surgical procedures.
 - ➡ good use of haptics is essential.
 - Simulation would alter dynamically in response to deformation forces such as respiration and needle insertion.
 - dynamic volume rendering from patient imaging data.

What is Interventional Radiology?

 A quite recent medical speciality which consists of minimally invasive diagnostics or treatments guided by images (usually fluoroscopy, ultrasound, CT, or MRI).



Catheter being passed over wire into a vessel. In IR, the practitioner does not look at his/her hands but at a monitor where images are displayed

Ultrasound Guided Needle Puncture (1/2)



Ultrasound Guided Needle Puncture (2/2)



Current Training Method

- IR procedures require special training of the visual and motor skills, and also eye-hand coordination
- IR training methodology still consists of close supervision in patients on the apprenticeship model:
 - See One
 - Do One
 - Teach One

- Problems:
 - patient safety
 - apprentice training reduces throughput
 - pressure to reduce length of training
 - deskilling due to reduced exposure



Alternative Training Methods using Fixed Models

























Hybrid Surface/Volume Haptic Model for Ultrasound Transducer



[1] F.P. Vidal, N.W. John, D.A. Gould and A.E. Healey: Simulation of Ultrasound Guided Needle Puncture using Patient Specific Data with 3D Textures and Volume Haptics. Computer Animation and Virtual Worlds, Volume 19, Issue 2, May 2008, pp. 111-127. DOI: 10.1002/cav.217

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Kidney and Liver Penetration Resistance Modelling using Radial Basis Function (RBF)



















Conclusion

- We develop dynamic volume renderings from static patient data sets
- Preliminary content validation studies of a framework developed for training on liver biopsy procedures, demonstrated favourable observations that are leading to further revisions, including implementation of an immersive VE.

Contact Details

Dr Franck P. Vidal f.p.vidal@bangor.ac.uk

Bangor University http://www.hpv.cs.bangor.ac.uk/

CRaIVE - Collaborators in Radiological Interventional Virtual Environments http://www.craive.org.uk/

THANKS