Improving the modeling of Medical Imaging data for simulation.

Authors: PF Villard, P Littler, V Gough, FP Vidal, C Hughes, NW John, V Luboz, F Bello, Yi Song, R Holbrey, A Bulpitt, D Mullan, N Chalmers, D Kessel, D Gould

PURPOSE-MATERIALS:
To use patient imaging as the basis for developing virtual environments (VE).

BACKGROUND
Interventional radiology basic skills are still taught in an apprenticeship in patients, though these could be learnt in high fidelity simulations using VE. Ideally, imaging data sets for simulation of image-guided procedures would alter dynamically in response to deformation forces such as respiration and needle insertion. We describe a methodology for deriving such dynamic volume rendering from patient imaging data.

METHODS

With patient consent, selected, routine imaging (computed tomography, magnetic resonance, ultrasound) of straightforward and complex anatomy and pathology was anonymised and uploaded to a repository at Bangor University. Computer scientists used interactive segmentation processes to label target anatomy for creation of a surface (triangular) and volume (tetrahedral) mesh. Computer modeling techniques used a mass spring algorithm to map tissue deformations such as needle insertion and intrinsic motion (e.g. respiration). These methods, in conjunction with a haptic device, provide output forces in real time to mimick the 'feel' of a procedure. Feedback from trainees and practitioners was obtained during preliminary demonstrations.

RESULTS
Data sets were derived from 6 patients and converted into deformable VEs. 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.

CONCLUSION:
It is possible to develop dynamic volume renderings from static patient data sets and these are likely to form the basis of future simulations for IR training of procedural interventions.