

Open-source training platform for ultrasound-guided needle insertions

Tamas Ungi, Andras Lasso, Gabor Fichtinger

School of Computing, Queen's University, Kingston ON, Canada

Ultrasound (US) has many advantages over other imaging modalities in guidance of medical interventions. But training medical students and residents how to perform US-guided interventions is a difficult task for the experienced physician. Difficulties are caused by low resolution, attenuation of the US signal, and that 3D reconstruction is not possible in certain scenarios. The simultaneous manipulation of a 2D US transducer and the interventional device requires a lot of practice when using such limited tools in navigation.

To address the difficulties in training by providing feedback for learners in an augmented reality environment, we have designed the Perk Tutor, a configurable, open-source training platform for US-guided needle insertions. The Perk Tutor may serve as a framework to rapidly develop training systems with anatomical or pathological phantom models, tracking and 3D display of tools and targets, record tracked motion, and evaluate trainee performance from the recorded data.

Our implementation consists of open-source modules for the 3D Slicer application. The Perk Tutor was successfully tested in three different configurations to demonstrate its adaptability to different procedures and learning objectives. (1) The Targeting Tutor, designed to develop US-guided needle targeting skills, (2) The Lumbar Tutor, designed for practicing US-guided lumbar spinal procedures and (3) The Prostate Biopsy Tutor, configured for US-guided prostate biopsies. The Perk Tutor provides the trainee with procedure-specific, quantitative feedback on progress towards the learning objectives of each configuration. Configurations were implemented through simple re-arrangement of hardware and software components, attesting to the modularity and ease of configuration.

The Perk Tutor is provided as a free resource to enable research and development of educational programs for US-guided intervention.