MRI-Guided Needle Placement with Augmented Reality Guidance

Researchers at the CISST ERC, in collaboration with clinicians at the Johns Hopkins Hospital, funded by Siemens, have developed a robust and inexpensive augmented reality apparatus to aid image-guided needle placement on conventional closed high-field Magnetic Resonance Imaging (MRI) scanners.

MRI has an unmatched potential for guiding, monitoring and controlling minimally invasive percutaneous (needle-based) interventions. At the same time, MRI presents formidable challenges. The high magnetic field precludes conventional materials and devices, and access to the patient inside the magnet is severely limited. We have been developing robots for in-scanner use, but they are unlikely to be clinically practical in the near future. Thus we also focus on augmented reality solutions that can become available in the close future and can be disseminated across a wide range of care facilities with minimal cost and overhead.

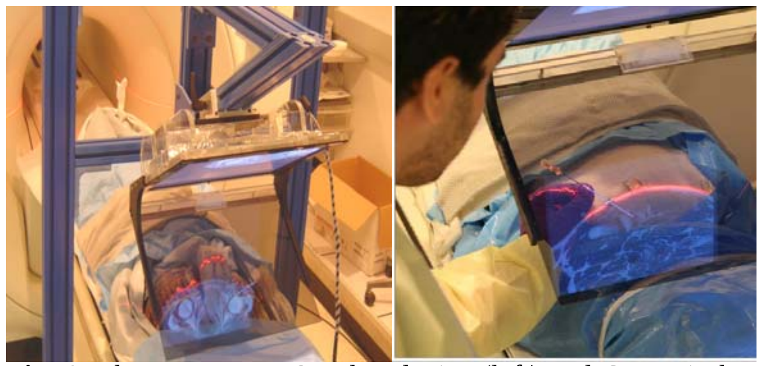

Fig. 1: The MR Image Overlay device (left) and Greg Fischer doctoral student performs needle insertion in a cadaver (right)

A wide variety of virtual reality methods have been investigated by other groups, but all prior solutions require painstaking calibration, and spatial tracking of all actors and components, resulting in complex, cumbersome, and invariably expensive systems. The device developed at the CISST ERC consists of a flat LCD display and a half mirror, mounted in the mouth of the MR magnet (Figure 1.) When the practitioner looks at the patient through the mirror, the MR image appears to be floating inside the patient with correct size and position, thereby providing the physician with tomographic vision to guide the needle placement. The physician inserts the needle following the optimal path identified in the MR image and reflected in the mirror. The system promises to increase needle placement accuracy and reduces patient discomfort and procedure time by eliminating faulty insertion attempts. Extensive cadaver studies have been conducted for several applications with a clinically applicable device. Drs. John Carrino, Laura Fayad, and James Zinreich at the Johns Hopkins Medical Institutions will be introducing the device to clinical trials in musculoskeletal biopsies and joint arthrography (Figure 2.)

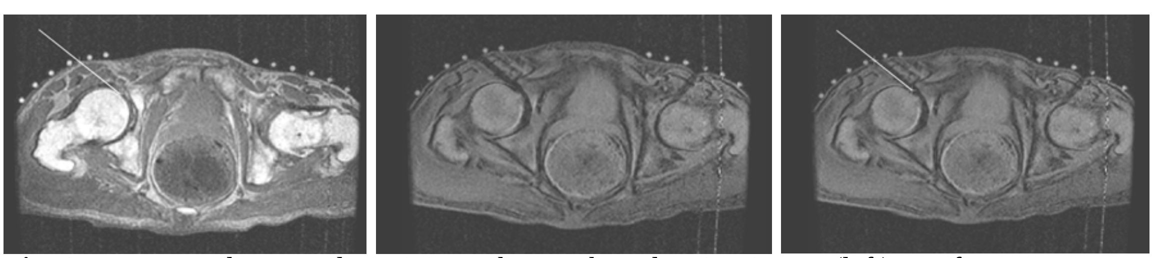

Fig. 2: Human cadaver study in joint arthrography: planning image (left), confirmation image with the dark needle tract (mid), and the plan overlaid on the confirmation image (right)