MOBILE IMAGE OVERLAY SYSTEM FOR IMAGE GUIDED INTERVENTIONS

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Purpose: An image overlay guidance system has been proposed previously for aiding needle placement interventions [1, 2]. In this technique, a 2D computer display image is reflected by a semi-transparent mirror, so that the virtual image appears floating inside the patient in correct 3D position. This concept provided accurate transverse image guidance for musculoskeletal interventions of the shoulder, hip and spine [3, 4, 5, and 6]. The previous, static mounting of the system was either fixed to the CT/MR imaging system or on a floor-mounted frame over the patient table. This mounting required careful calibration before each procedure, and was prone to misalignments due to structural deformation or unintended physical contact with the device. Furthermore, the static mount limited the access to the patient and excluded clinically relevant ranges of motions of the tool and the physician. To overcome those limitations, we propose the Mobile Image Overlay System (MIOS).

Methods: The MIOS consists of a 2D image overlay system, similar to the one used in [1] and it is attached to a floor-mounted articulated arm (Figure 1). The physician moves the MIOS freely over the patient. It is equipped with optical markers to report its pose during the entire procedure. Another optical marker is fixed to the patient for co-registration of scanned images and the MIOS. After imaging, the physician performs the surgical planning, and the MIOS is positioned over the target anatomical region. Depending on the tracked position of the MIOS, the software displays the correct image on the overlay monitor. Therefore, the image is virtually displayed inside the patient, providing image guidance to the physician while seeing through the mirror. At any desired position, the MIOS can be locked firmly.

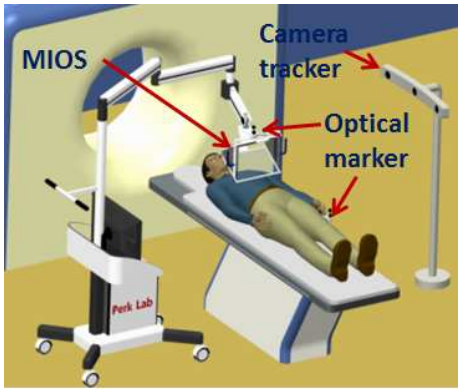

Fig1: MIOS concept

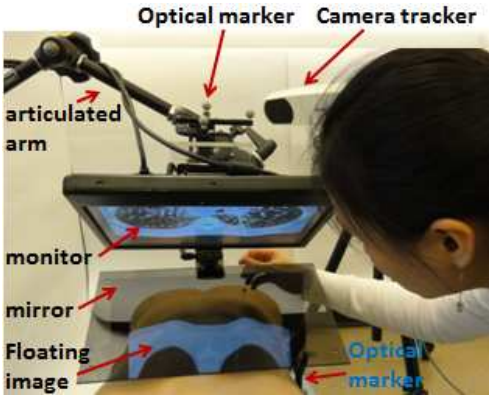

Fig2: MIOS prototype

Results: The MIOS concept is shown in Figure 1 along with the tracker camera. The first prototype developed for demonstrating the proof of concept is shown in Figure 2 and shall be used to conduct phantom experiments and define system ergonomics. For the articulated arm, we plan to mount the image overlay system on an arm similar to the one used in the Calypso system, (Calypso Medical Systems, USA). The following generation of MIOS will be also MRI-compatible.

Conclusion: Based on successful pre-clinical testing of the static image overlay system, the mobile image overlay promises to become a useful tool for image-guided interventions, such as musculoskeletal needle injections, parathyroidectomy, percutaneous nephrolithotomy and percutaneous access to blood vessels.

References: **[1]** Fichtinger *et al., IEEE transactions on biomedical engineering, 52(8), 2005*; **[2]** Weiss *et al., American Journal of Roentgenology, vol.196, 2011*; **[3]** Fischer *et al*., *Journal of Computer Aided Surgery, 12(1), 2007;* **[4]** Fritz *et al., American Journal of Roentgenology, 198(3), 2012;* **[5]** Fritz *et al., European Radiology, 23(1), 2013*; **[6]** Fritz *et al., Investigative Radiology, 48(6), 2013.* *(This work was jointly funded by the NIH R01 CA118371, the Natural Sciences and Engineering Research Council of Canada and Cancer Care Ontario.)*