Development of a System to Integrate Continuous MR Images and Active Tracking Data

B. Fetics[1], D. Polenur[1], S. G. Hushek[2], A. Roth[1], E. Nevo[1]
[1]Robin Medical, Inc., Baltimore, MD, United States, [2]Norton Hospital, Louisville, KY, United States

Introduction

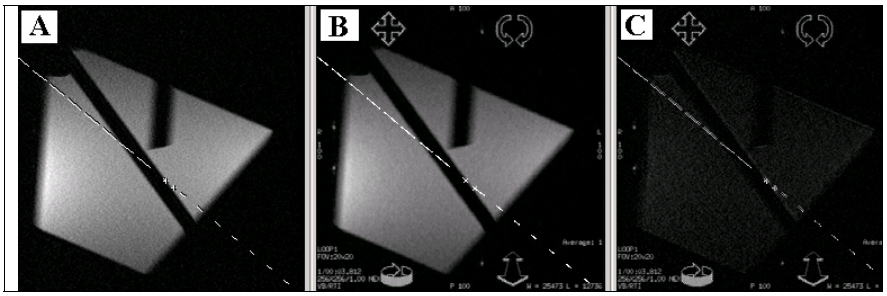
An active tracking system based on MRI gradient fields (EndoScout, Robin Medical, Inc.) has been developed [1]. However, only a few models of MRI scanners have the ability to accept and incorporate tracking data. Therefore, to allow the use of the tracking system on a larger population of MRI scanners, we aimed to develop a system (Surgical WorkStation, or SWS) which would accept and merge the real time MR images and the real time tracking data.

Methods

System - Tracking data was communicated via serial communication to the SWS from the independent tracking computer. The MR image was sent to the SWS via ethernet and the image/slice specifications, such as its orientation in space, were extracted from the header of the MR Dicom file. Real time MR image display was obtained via a video capture (Xpert DVD Maker USB2.0, K-world Computer Co.) of the MRI scanner computer monitor, and communicated via RCA cable and NTSC video standard. The annotation was drawn onto the MR image display of the SWS through the use of geometry algorithms.

Experiment and Image Analysis - An EndoScout tracking device and an MR contrast-filled phantom were placed within the imaging volume of a Signa SP/i MRI scanner (GE Medical Systems, Waukesha, WI). Ten (10) comparison image sets, consisting of different locations/orientations of the phantom and of different scanning planes, were obtained. Each image set consists of (1) the annotated MR image generated by the Signa SP/i (the reference) and (2) the annotated MR image display generated by the SWS computer (new method). The angle of the annotation (when applicable) and the location of the "virtual needle tip" were determined for each image. In addition, a subtraction image was formed for each set.

Results



An example result is shown at right. Panel A is the MR image formed by the Signa SP/i scanner. Panel B is the MR display formed by the SWS computer. Panel C is the subtraction image. Here the annotation angles differ by 0.06 deg. and the needle tip locations differ by 1.10 mm. In the subtraction image, the phantom is not visible (meaning there is no significance difference between the two images), and the two annotation lines differ by 0-2 pixels. For the 10 comparison sets, the annotation angles differ by (Mean +- S.D.) 0.30 +- 0.23 deg. (n=7) and the needle tip locations differ by 1.19 +- 0.65 mm (n=10).

Conclusion

The SWS system provides similar image quality as the scanner and an accurate representation of tracking annotation during real time MR imaging, facilitating the use of active tracking on MR scanners which currently lack this ability.

References

[1] E. Nevo, A. Roth, S.G. Hushek. An Electromagnetic 3D Locator System For Use In MR Scanners. In ISMRM Proceedings, volume 10. International Society for Magnetic Resonance in Medicine, May 2002. talk 0334.