Full Record

Title: Effect of geometrical distortion correction in MR on image registration accuracy

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Abstract: In this article we investigate the effect of geometrical distortion correction in MR images on the accuracy of the registration of X-ray CT and MR head images for both a fiducial marker (extrinsic point) method and a surface-matching technique. We use CT and T2-weighted MR image volumes acquired from seven patients who underwent craniotomies in a stereotactic neurosurgical clinical trial. Each patient had four external markers attached to transcutaneous posts screwed into the outer table of the skull. The MR images are corrected for static field inhomogeneity by using an image rectification technique and corrected for scale distortion (gradient magnitude uncertainty) by using an attached stereotactic frame as an object of known shape and size, We define target registration error (TRE) as the distance between corresponding marker positions after registration and transformation. The accuracy of the fiducial marker method is determined by using each combination of three markers to estimate the transformation and the remaining marker to calculate registration error. Surface-based registration is accomplished by fitting MR contours corresponding to the CSF-dura interface to CT contours derived from the inner surface of the skull. The mean point-based TRE using three noncollinear fiducials improved 34%-from 1.15 to 0.76 mm-after correcting for both static field inhomogeneity and scale distortion. The mean surface-based TRE improved 46%-from 2.20 to 1.19 mm. Correction of geometrical distortion in MR images can significantly improve the accuracy of point-based and surface-based registration of CT and MR head images. Distortion correction can be important in clinical situations such as stereotactic and functional neurosurgery where 1 to 2 mm accuracy is required.

Author Keywords: image registration; magnetic resonance imaging, physics and instrumentation; image correction; magnetic resonance imaging, techniques

KeyWords Plus: MAGNETIC-FIELD INHOMOGENEITIES; STEREOTAXIC NEUROSURGERY; SPATIAL DISTORTION; 3-DIMENSIONAL REGISTRATION; OPERATING MICROSCOPE; GUIDED NEUROSURGERY; AUTOMATED ALGORITHM; PRINCIPAL AXES; BRAIN IMAGES; NMR IMAGES

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