

AbstractID: 5413 Title: Analytical Quality Assurance Criteria For CT-MRI Mutual Information Image Fusion

Purpose:

To use point-based error metrics as an analytical criterion for CT-MRI mutual information (MI) image fusion.

Method and Materials:

A commercially available MI algorithm was used to fuse CT and MRI image sets for 5 patients. Three corresponding anatomical landmarks were manually identified on CT and MRI to initialize the fusion algorithm. All landmarks, designated A(CT) and A(MRI), were identified by a single expert user. A program was developed to extract the CT and MRI point coordinates, scaling factors and homogenous transformation matrix M from the commercial system. The parameters were used to calculate the "ideal" MRI coordinates, $A'(MRI) = M * A(CT)$, that analytically always produce zero documented error by the manufacturer's software. The difference between the ideal calculated $A'(MRI)$ and the user indicated MRI data set A(MRI) was then analyzed in terms of standard point-based error metrics, Fiducial Localization Error (FLE) and Fiducial Registration Error (FRE). The program also performs the inverse transformation, $A'(CT) = M^{-1} * A(MRI)$, into CT space for a similar error analysis.

Results:

The FLE was determined, by statistical analysis in the form of the repeated digitization of the anatomical landmarks by the same expert user, to be 0.6mm (+/- 1 pixel). The range of FRE for the 5 patients was 2.2 mm to 2.5 mm. Visual inspection of the MRI points transformed into CT space clearly indicated that the fusion error was as much as 20% of the cone diameter for small treatment cones and therefore clinically significant.

Conclusion:

FREs as large as 2.5 mm are dosimetrically significant given that typical dose gradients in stereotactic radiosurgery are 10%/mm. In addition to being representative of the performance of the MI fusion, FRE should be considered when determining clinical target margins for stereotactic target delineation.

Conflict of Interest (only if applicable):