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, \( A'(MRI) = M \cdot A(CT) \), 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, \( A'(CT) = M^{-1} \cdot A(MRI) \), 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):**