AbstractID: 3798 Title: A method for validation of image fusion software for PET and CT coregistration for brain radiotherapy

Purpose: A technique is described to quantitatively evaluate several methods for coregistering PET and CT images: 1) manual registration based on fiducial markers, and 2) automated registration using several commercial algorithms that maximize mutual information.

Method and Materials: CT and PET scans of an Alderson Striatal head phantom were obtained with and without three rectangular fiducial markers (1 mm × 1 mm × 3 mm). Each marker contained 10 μCi of Na-22 along with contrast agent so markers were visible on both CT and PET scans. Several CT scans were acquired with a pixel size of 0.7 mm × 0.7mm of the phantom rotated by known amounts along the principle axes. PET scans were obtained at two resolutions, 2 mm× 2 mm and 4 mm × 4 mm pixels, at a single orientation (supine, zero rotation). For these scans the main compartment of the phantom was filled with F-18-FDG at clinically-observed concentrations. Transmission scans also were obtained.

Results: The accuracy of both automatic and manual coregistration of the emission PET to the CT was evaluated by comparing the transformation matrices (TM) to the known displacements. Image fusion between different CT and the PET scans show TM within 2-4 degrees of the known rotation for manual fusions and 1-3 degrees for automated registration. A subjective qualitative evaluation of the results based on the structures in the phantom and intensity pattern showed agreement to within 2 mm for higher resolution PET scans. Results were similar for registration of the transmission PET to the CT. Because these results are based on rigid-body motions, they establish an upper-bound on the accuracy obtainable from these registration techniques.

Conclusion: A method has been developed to assess and quantitatively evaluate image coregistration software for CT and PET images.