AbstractID: 10372 Title: MRI-to-CT deformable registration for treatment planning of breast irradiation

Purpose: Breast MRI provides enhanced tissue differentiation and physiological information that greatly improves the delineation of targets for breast cancer radiotherapy. MRI needs to be registered with CT as the CT provides the electron density information for dose calculation and alignment in IGRT. We are developing a technique to deformably register MRI to CT, allowing for the transfer of the MRI-defined structures to the CT for dose calculation, and the dose distribution from CT to MRI for outcome analysis.

Method and Materials: An MRI data series was acquired, using a breast coil on a large bore 3T scanner (Verio, Siemens), with prone patient position using multiple sequences including T1, T1 fat saturation (FS), T2, T2FS, and T1FS with contrast. A CT was taken shortly after MRI acquisition. The multi-form MRIs were rigidly registered to the CT. Anisotropic (edge preserving) noise filtering is applied to the images. A deformable image registration program developed using ITK then registers the MRIs individually to the CT using B-Spline with Mattes mutual information as a metric and LBFGSB as the optimizer. MRI-defined structures were overlaid on the CT for treatment planning, and the dose distribution transferred from CT to MRIs for analysis of radiation response based on multi-form MRIs, using the deformation field obtained.

Results: Multi-form MRIs for prone breast were successfully registered to CT as gauged by high mutual information. Registration amongst the MRI modalities showed negligible deformation between them. T1FS registered best with the CT. Consequently its deformation field was used to deform the other MRIs. This improved the agreement between these MRIs and the CT over their individual registration. The deformation field was used for dose overlay on multi-form MRIs.

Conclusion: The deformable image registration tool developed successfully registers multi-form MRIs to CT for treatment planning of prone breast radiotherapy.