AbstractID: 7370 Title: Deformable image registration using FDG-PET/MRI for metastatic breast cancer detection

Introduction: Diagnostic imaging techniques using fluoro-deoxy-glucose (FDG) - positron emission tomography (PET) and magnetic resonance imaging (MRI) offer tumor-specific imaging capabilities for breast cancer imaging. Combining PET-MRI systems may provide synergistic information on abnormal soft tissue processes useful for discriminating tumor from other soft tissue abnormalities that may mimic tumor. We propose a deformable image registration method able to align MRI series over an FDG-PET dataset which may improve metastatic for breast cancer imaging.

Method: To more precisely replicate presentation of FDG-PET when analyzing FDG-PET/MRI, a deformable registration method was devised to correct locally defined posture changes. To mathematically represent the deformations, we use a BSpline model whose coefficients are iteratively calculated in small steps using a gradient-based optimization algorithm under the guidance of a mutual information metric. The deformable BSpline approach technique was evaluated using checkerboard views and compared to a rigid body registration.

Results: Comparison of rigid versus deformable registration of checkerboard FDG-PET and MRI images revealed superior results for deformable registration. The deformable registration was feasible and showed exact anatomical correlation between FDG-PET and MR images in a checkerboard. Increased activity from the FDG-PET scan clearly corresponded to anatomical structures on the MR images. Clinically, the deformable registration of FDG-PET and MRI revealed the complimentary information. Regions of increased FDG activity on PET-CT, which was initially rated as possible tumor disease, were evaluated based on the additional soft tissue information available from the MRI. In one patient case, MRI revealed a benign uterine fibroid which was not definitive on PET-CT.

Conclusion: Deformable image registration of PET-CT and MRI using a BSpline algorithm is feasible for metastatic breast cancer detection.