AbstractID: 4631 Title: Deformable Registration for In Vivo Imaging and Pathology Correlation

Purpose: To describe a deformable registration infrastructure to resolve the geometric discrepancies between in vivo imaging studies and histology from resected tumor specimens to reduce uncertainties in tumor definition.

Method and Materials: An IRB approved prospective study investigating the correlation between in-vivo CT and MR imaging, ex-vivo specimen imaging and pathologic sections from colorectal cancer liver metastases treated by resection was developed to better define gross and clinical tumor volume. Triphasic liver CT scans, PET-CT scans and MR scans were obtained in 6 patients within 4 weeks prior to liver resection. On the day of surgery, the fresh liver hepatectomy specimen was imaged using MR. The specimen was fixed and reimaged with MR prior to pathological evaluation. Axial sectioning was done at the time of pathological evaluation, with photos of each liver slice digitized. Histological evaluation was performed on the sections representing the largest tumor. Gross tumor was identified on all images sequences. Gross tumor, microscopic tumor and vascular changes of interest were also identified on the gross and histological pathological specimens. A finite element model-based deformable modeling algorithm, MORFEUS, was used to resolve the geometric discrepancies due to changes in the position of the liver between each imaging sequence and session through a guided surface projection and finite element analysis.

Results: Deformable registration can be used to facilitate comparison of imaging to pathological specimens. In the liver, substantial specimen shrinkage and deformation were seen necessitating deformable image registration. The accuracy of MORFEUS to relate the pathology-histology to the in vivo imaging was within the slice thickness (5 mm) of the pathology sectioning, determined via identified vessel bifurcations in the liver.

Conclusion: An accurate deformable modeling infrastructure has been established to relate the geometric position of the liver and excised liver specimen on different imaging modalities and histology.