AbstractID: 2101 Title: Effect of Flat-fielding on Intensity-based Registrations using Electronic Portal Imaging Devices (EPIDs) in Radiotherapy

Image registration in conjunction with EPIDs is increasingly being used for patient positioning. Image registration can be based on fiducial markers, edges or intensity-based measures. We investigate mutual information (MI) and correlation coefficient (CC), intensity-based measures commonly used in medical imaging, for automated registrations in radiotherapy. EPID images are registered with digitally reconstructed radiographs (DRRs) using MI and CC. Two EPIDs are considered: Seimens BEAMVIEW(PLUS), video camera based, and Varian PortalVision AS500, amorphous silicon flat panel based. The BEAMVIEW images were corrected for spatial distortion (due to optics) using a second order piecewise spline fit. The AS500 images were flat-fielded using the manufacturer's standard procedure to correct for individual pixel response variation. A plexiglass jig containing a fixed anthropomorphic cranial phantom and fiducial markers was assembled. The fiducial markers were used as the gold standard. Using MI and CC, the EPID-EPID registrations for both EPIDs yielded an accuracy of <1.0mm (1pixel=0.51mm), while the EPID-DRR registrations yielded errors of 1.5-5mm, inclusive of local maxima trapping. After performing an additional flat-fielding using an EPID image of an open field in presence of uniform thickness of solid water, the multimodality registration errors were significantly reduced with no local maxima trapping. For an optimal solid water thickness of 20cm, the multimodality registration errors were reduced to 1mm and 2mm for MI and CC respectively. This suggests that flat-fielding considerations based on non-uniform x-ray flux, anatomical scattering and beam hardening must be included if an intensity-based registration is to be used.