AbstractID: 7017 Title: Automatic target position verification with 3-D reconstruction of implanted markers using EPID images

Introduction: In previous studies, a technique using an electronic portal imaging devices (EPIDs) in *cine* mode has been validated for tracking gold fiducials implanted in the liver for respiratory gating and stereotactic body radiation therapy. However, it was time-consuming and labor-intensive since the marker recognition was not performed automatically. In this study, we present an automatic algorithm to quickly and accurately extract the markers in EPID images and reconstruct their 3-D positions.

Materials and Methods: The markers were placed in a solid water phantom. Images were acquired using a linear accelerator operating with the 6 MV photon beam at several gantry angles and couch angle positions. A sequence of images was created by collecting the exit radiation using the EPID in *cine* mode. The fiducials were recognized and detected using a sequence of filters including the Wiener, median, and Laplacian filters. The position of each seed in the EPID images was backprojected towards the source position at each beam angle. To reconstruct the optimized seed position in 3-D, the centroid and Gaussian fit were applied respectively to the distribution of the center points.

Results: The average displacement between the seed positions reconstructed with the EPID images and the seed locations in 3-D CT image is measured to be 3.57 ± 2.59 mm (0.44–7.66 mm) using the centroid. Using Gaussian fit we can accurately reconstruct the marker locations with 0.98 ± 0.38 mm positioning error (0.39–1.47 mm) by significantly reducing the statistical error introduced by the outliers arising from anti-parallel beam projections.

Conclusions: The 3D positions of implanted fiducials can be reconstructed using images from several beam angles. This algorithm will be used for patient data to find the average 3D target position *during* radiotherapy treatment.

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