Abstract ID: 19385    Title: Real-Time Fiducial Detection and Prostate Movement Assessment with Cine MV Images in RapidArc Treatments

Purpose: To develop an algorithm for detection of metallic fiducial markers in cine MV images, and to assess the prostate movement during RapidArc treatment.

Methods: A Varian TrueBeam linear accelerator (LINAC) was used to deliver RapidArc treatment for prostate patients. Cine images were acquired with the onboard electronic portal imaging device (EPID) using the MV therapeutic beam. Three metallic fiducial markers were implanted inside the prostate. To detect the fiducial position, we explicitly account for the possible marker blockage by MLC during beam modulation. If the marker is not blocked, we employ the planning coordinates of the marker centroids projected onto the cine MV images and perform template matching in the vicinity of its projection to localize the actual position of the marker. Displacements of the fiducial markers are assessed by comparing the actual and planned positions.

Results: We analyzed ~280 cine MV images acquired during a 55-sec RapidArc treatment for a prostate patient. The three markers were visible in about 46%, 52%, and 48% of the images, and at least one fiducial was visible during almost entire treatment (97% of the time). The marker detection algorithm agrees well with manual detection (< 0.2 mm). The mean displacement for each fiducial was 0.40 ± 0.42, 0.27 ± 0.29, and 0.46 ± 0.34 mm. The maximum displacement was 2.33, 1.75, and 2.23 mm.

Conclusions: An algorithm for automatic detection of fiducial markers in cine MV images has been developed. The prostate movement during a RapidArc treatment has been analyzed for a patient with implanted markers. Accurate target positioning is achieved at all times during treatment. In light of the random nature of intrafraction prostate motion, this work represents an important step toward real-time image-guided prostate radiation therapy.