AbstractID: 4693 Title: Registration of x-ray portal images with 4DCT DRRs for patient setup verification

Purpose:

To provide a noninvasive method for both setup verification of 4DCT treatment planning and isocenter positioning shifts for treatment delivery.

Method and Materials:

A ten phase 4DCT treatment planning study of the patient was acquired using a respiratory gating system. When the patient was on the treatment couch, multiple on board x-ray images were taken in the anterior-posterior (AP) and lateral directions. An intensity based rigid registration algorithm was applied to obtain optimal shifts in the x, y and z directions. First, a digitally reconstructed radiograph (DRR) using ray-casting algorithm was computed from one of the ten phases of the 4DCT. The correlation coefficient (CC) between the DRR and the x-ray image was then calculated. The 4DCT volume was shifted and new DRRs were generated until the maximum CC value was reached through an optimization process. This procedure was repeated for all ten 4DCT phases.

Results:

Registration of each phase of the 4DCT with the x-ray image provided ten maximum CC values. These values exhibited a single maximum at the phase corresponding to the breathing phase when the x-ray image was taken. The corresponding isocenter positioning shifts for treatment delivery were also obtained. The robustness of our algorithm was demonstrated by registering x-ray images taken at five random phases to 4DCT. The resulting isocenter shifts were consistent between all phases. The standard deviations of the shifts determined for the AP x-rays were 2 mm (lateral), 5 mm (anterior-posterior), and 2 mm (superior-inferior).

Conclusion:

Using only the RPM system, one cannot be certain that the internal anatomy is consistent between 4DCT acquisition and any particular treatment day. Our noninvasive method accounts for internal organ motion and may be used for daily 4DCT treatment setup verification and isocenter positioning.