

Purpose

The purpose of this work is to devise an efficient, effective and routine imaging modality to guide lung radiotherapy. Current methods involve acquiring a 4D-CBCT and comparing the digitally reconstructed radiographs (DRRs) for multiple breathing phases with online fluoroscopic images. A major shortcoming of DRRs and fluoroscopy is that unwanted structures such as bones occlude the target. Furthermore 4D-CBCT requires long acquisition times and large patient dose, making it impractical for routine use.

Method and Materials

We propose a partial arc cone beam acquisition, which we call “cone beam digital tomosynthesis” (CBDT), to obtain cross-sectional images of a slab just thick enough to enclose the soft tissue target. Projections through this slab make “digitally reconstructed tomograms” (DRTs). Similar to DRRs, DRTs correct for beam divergence. However, different from DRRs, DRTs do not contain irrelevant structures outside the slab, making the target far more conspicuous. By gating this acquisition, dynamic cross sections and DRTs are obtained at multiple respiratory phases. These dynamic images are registered with those obtained from the planning 4D-CT dataset to guide treatment.

Results

The DRRs constructed from multiple phases of a 4D-CT emphasize bony anatomy and other irrelevant structures overlaying the target, making the edges of the target difficult to find. We have demonstrated that this difficulty is overcome by the use of cross-sectional images from CBDT and DRTs, which are obtained with an image acquisition time that is significantly shorter than full-volume 4D-CBCT. Matching DRTs were obtained from the planning 4D-CT for each phase. 2D-2D registrations were performed to obtain the phase-varying offset.

Conclusion

A new imaging technique has been introduced for image-guided lung treatment. With this approach, images are acquired faster and the appearance of the tumor is significantly enhanced by eliminating many extraneous structures.

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