AbstractID: 11737 Title: Accurate image reconstruction from incomplete kilovoltage cone-beam CT data in radiation therapy

Purpose:
Kilovoltage cone-beam CT (CBCT) is becoming an increasingly important clinical tool for image-guided radiation therapy. Current CBCT imaging procedures acquire data from hundreds of angular views, during which considerable amount of radiation dose is deposited in the patient body. This raises patient safety concerns as CBCT is often used for frequent image acquisitions. Dose reduction can be achieved in part by acquiring data collected from a considerably reduced number of views. In this work, we develop a total-variation-minimization-based image reconstruction algorithm (TV algorithm) to reconstruct images for situations when only a fraction of full-scan CBCT data is acquired in radiation therapy.

Materials and methods:
The TV algorithm seeks among all the image candidates satisfying a given data-fidelity tolerance the one with minimum total variation. Projection onto convex sets (POCS) and gradient-descent techniques were used in the algorithm to achieve this goal. To test the algorithm, we acquired 856-view CBCT data of a home-built phantom with the on-board imaging (OBI) system mounted on a Trilogy linear accelerator (Varian Medical Systems, Palo Alto, CA). We then extracted 32-, 62-, and 96-view data for reconstruction using TV and other analytical and iterative algorithms.

Results:
Among all the tested reconstruction algorithms, the reconstructed images using TV algorithm is least contaminated with artifacts caused by insufficient angular sampling, and the low-contrast object in the phantom is most distinguishable from background in TV reconstructed images.

Conclusion:
The proposed TV algorithm produces more accurate reconstruction images than other algorithms in the tested cases where only a fraction of the full dataset is used. The TV algorithm may be potentially useful in reducing radiation dose in CBCT image-guided radiation therapy.