AbstractID: 13091 Title: A novel off-axis scanning method for improved CBCT FOV and reconstruction using compressed sensing

Purpose: Current on-board imaging systems commonly used by modern linear accelerators have a limited field of view (FOV) for a cone-beam CT (CBCT) scan, which is typically less than 50 cm. Consequently, truncation artifacts often occur for large patients. The goal of this work is to investigate a novel method to increase the FOV for current on-board CBCT systems.

Method: When a large patient is scanned with CBCT, any region outside the FOV is only partially sampled within a short range of projection angles, and at any other angles no x-ray beams may pass through that region. To increase the sampling rate for the region outside the FOV, we have designed a new source trajectory by shifting the center of rotation during a CBCT scan. This resulted in a reduced sampling rate at the central area and increased sampling rate at the edges. The tradeoff led to a more balanced sampling for an increased FOV. An iterative algorithm was also developed in order to reconstruct the CT image under the new sampling scheme using a compressed sensing technique. The method was validated by computer simulations for a Varian Trilogy CBCT system. A phantom created from CT images of a lung patient was used in the simulations. The isocenter movement followed a near-ellipse trajectory while the x-ray source/detector rotated around the object.

Results: Under the clinical half-fan settings with FOV of 45 cm, the truncation artifacts were tremendous for the simulated CBCT scanS. With the new scanning method, artifact-free imageS can be obtained with the FOV as large as 75 cm.

Conclusions: A novel CT scanning geometry was designed and tested, which can dramatically increase the FOV without significant compromise of the CBCT image quality.