AbstractID: 14033 Title: Development of a Tetrahedron Beam Computed Tomography Benchtop System with a 75 Pixel Field Emission X-Ray Tube: System Setup and Performance Evaluation

Purpose: Cone-beam computed tomography (CBCT) is an important online imaging modality for image-guided radiotherapy (IGRT). But its image quality is significantly inferior to diagnostic CT due to excessive scatters and suboptimal detector performance. We are developing a novel Tetrahedron Beam Computed Tomography (TBCT) imaging system which circumvents the inherent problems of CBCT. A TBCT benchtop system has been built with a 75 pixel field emission x-ray. Imaging studies are performed.

Method and Materials: The TBCT imaging system consists of a linear x-ray source array and a linear detector array which are aligned perpendicular and parallel to rotation plane respectively. A TBCT benchtop system has been built with a 75-pixel field emission x-ray tube. A 5-row CT detector array was built using silicon photodiodes and $CdWO_4$ scintillators. The x-ray beams are collimated to fan-shape by a group of multi-slot collimators. System control and data acquisition hardware and software were developed. TBCT image reconstruction algorithm was adapted from FDK CBCT algorithms.

Results: Due to its scatter rejection geometry and the use of high-performance discrete x-ray detectors, TBCT image quality is expected to be comparable to that of diagnostic fan beam CT. The TBCT benchtop is fully functioning except the scanning time has to be prolonged due to the low tube output. Initial phantom scans produced excellent images without scatter artifacts. Currently we are performing final system tune-up and image quality evaluation.

Conclusion: TBCT would significantly improve online image quality. Clinical implementation of TBCT would improve the precision of IGRT treatments. A higher power tube is desired for clinical TBCT systems.

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