AbstractID: 14128 Title: Development of a Tetrahedron Beam Computed Tomography Benchtop System with a 75 Pixel Field Emission X-Ray Tube: Collimator Design and Image Reconstruction

Purpose: We are developing a novel Tetrahedron Beam Computed Tomography (TBCT) benchtop system using a multiple pixel x-ray tube with 75 carbon nanotube field emission cathodes and an in-house curved CT detector array. In this paper, we describe the development of multi-slot collimators and image reconstruction algorithms.

Material and Methods: The 75 x-ray sources are arranged in a linear array with 4 mm cathode spacing. The 5-row detector array is curved with a 145 cm radius. The linear scanning x-ray source array and a curved detector array are aligned perpendicular to and within the rotation plane, respectively, with the source array positioned precisely on the central axis of the detector array. A group of multi-slot collimators were designed to collimate the beam from each source exactly to the detector array. An FDK TBCT reconstruction algorithm was developed. Image reconstruction was performed using numerical and actual projection data.

Results: The shapes of each slot opening are partial ellipses. The slot geometries were derived and drawn using CAD software. Actual collimators were made using a chemical milling technique. The FDK TBCT image reconstruction algorithm was adapted from the cylindrical, equiangular detector cone beam reconstruction algorithms. The TBCT reconstruction was evaluated using numerical Shepp-Logan phantom as well as real phantom scans.

Conclusions: Multi-slot collimators were designed and built. The TBCT image reconstruction algorithm was able to accurately reconstruct 3D volume with both numerical and real projection data.

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This work is partially supported by NIH grant 1R21CA130330-01A1 and DOD Prostate Cancer Research Program W81XWH-07-0083.