AbstractID: 10334 Title: Performance Characterization of a MVCT Scanner using Multi-Slice Thick, Segmented Cadmium Tungstate-Photodiode Detectors

Purpose: To evaluate the performance of a MVCT system based on multi-slice, thick, and segmented cadmium tungstate-photodiode detectors.

Method and Materials: Our MVCT's detector is a 2D array of 1mm x 1mm (pitch) x 10mm (thickness) cadmium tungstate crystals separated by a septa paint of reflectivity higher than 0.975. The scintillators are mounted on ten 16 x 16 element photodiode arrays (SCA-CA256ES, Semicoa, Costa Mesa, CA). The total array size is 320 detectors along the arc by 16 detectors along the slice thickness direction. The radius of curvature of detector arc is 92.5cm. In our system, the source and detectors remain stationary while the object being imaged is placed on a precision rotating stage.

Due to the high dose per pulse provided by our clinical linac, it is not possible to image a test object with a dose of < 50cGy in a 6MV beam. In order to obtain low dose images, we used the small amount of Bremsstrahlung radiation produced in the scattering foils in 6 MeV electron beam after removing the electrons from the beam by placing 4cm of solid water in the beam.

Results: Our system demonstrates a uniformity index of 0.4% at 1.9cGy. The noise standard deviation is around 2% at 1.9cGy. CT number linearity (R^2= 0.9982) and low contrast resolution (15 mm object with 1.5% contrast at 2 cGy) are superior to published evaluations of commercially available tomotherapy MVCT. The spatial resolution is about 4lp/cm which is limited mainly by the diffused Bremsstrahlung source.

Conclusion: Thick segmented cadmium tungstate detectors offer significantly better low contrast resolution per unit dose at MV energy than commercially available gas filled or flat panel detectors. This work demonstrates the feasibility of creating a fully functional MVCT system using this technology.

Conflict of Interest (only if applicable): None