AbstractID: 3515 Title: Performance of a bench-top, megavoltage CT (MVCT) Scanner using Cadmium Tungstate-photodiodes

Purpose: To evaluate the imaging performance of a prototype fan-beam megavoltage CT (MVCT) scanner in Co^{60} and 6 MV beams.
Methods and Materials: The 80-element detector is fabricated by tiling 8-element $CdWO_4$ (element size 0.275 x 0.8 x 1 cm^3) and photodiode arrays and arranging them on an arc (radius = 110 cm). A precision rotary stage and its control are added to create a third generation CT scanner. The attenuation of Co^{60} and 6 MV beams was measured as a function of solid water thickness, and fit to a second order polynomial to correct for spectral hardening artifacts. A calibration procedure was established to remove ring artifacts caused by the distinctly asymmetric line spread functions at the ends of 8-element blocks. The low contrast resolution (LCR) as a function of dose and object size, the signal to noise ratio (SNR) as a function of dose, and the linearity of CT numbers with density were quantified.
Results: Throwing away one-ninth of collected projection angles to reduce the dose per image adversely affects the resolution in 6 MV images; however, 15 mm targets at 1.5% level are still visible at 7 cGy. The low contrast target of 1.5% at 6 mm diameter is visible in Co^{60} images at 2cGy. The LCR in the objects stays approximately constant with the dose reduced from 17 to 2 cGy. In general, the contrast decreases as the target diameter decreases. The SNR^2 obtained from a uniform phantom increases linearly with dose (R^2=0.9977). CT numbers as a function of the density show a linear trend (R^2= 0.9923).
Conclusion: The prototype detector performance is satisfactory to achieve the ultimate goal of this project of creating a focused 2-D MV detector with high detective quantum efficiency such that reasonable LCR at low dose can be obtained in MVCT.