Abstract ID: 17026 Title: Measurement of contaminant signals in clinically relevant CBCT image acquisition geometries and performance evaluation of bowtie filters.

Purpose: Bowtie filters are known to reduce fraction of the scatter signals in CBCT imaging, particularly in cylindrically symmetric image acquisition geometries. However, patient anatomy and imaging geometry during daily CBCT imaging for radiation therapy often lack this symmetry. In this work, the performance of bowtie filters on reducing contaminant signals was investigated for clinically relevant CBCT image acquisition setups.
Methods: A torso phantom with elliptical cross section was imaged using a clinical CBCT system mounted on a linac gantry. A lead beam stopper array was placed around the phantom to sample contaminant signal distribution as a function of gantry angle. CBCT 2D projection images were acquired with and without bowtie filter at two different isocenter locations in the phantom: one at the center (prostate imaging geometry), and one at the periphery of the phantom (liver or lung imaging geometry). For each image set, contaminant-to-primary signal ratios (CPR) were calculated in 20 projection views with equiangular spacing. Also, bowtie filter's efficacy on reducing the dynamic range of total image signal (primary+contaminant) was evaluated.
Results: For centrally located isocenter (prostate case), the median CPR was reduced from 1.1 (80th percentile range: 0.39-2.44) to 0.955 (0.49-1.89) with the use of bowtie filter. Relative total signal ranged from 0.21 to 18.4, and it was reduced from 0.25 to 10.72 with the bowtie filter. For peripherally located isocenter (lung/liver case), the median CPR decreased from 1.27(0.48-3.32) to 1.25(0.41-2.4) with bowtie filter. Relative total signal ranged from 0.17 to 13.57, and it increased from 0.24 to 31.6 with the bowtie filter.
Conclusions: Although the use of bowtie filter may appear to be simple and effective in reducing contaminant signals and the dynamic range requirements, a single universal design may have suboptimal efficacy for the variety of patient imaging geometries typically observed in radiation therapy setting.