

AbstractID: 12661 Title: Monte Carlo Simulated Effects of Bowtie Filtration on Scattered Radiation in CBCT

Purpose: X-ray scatter in cone-beam CT (CBCT) is known to cause image artifacts, contrast reduction, and CT number inaccuracy. The extent of the effect of x-ray scatter on CBCT image quality is determined by the shape and magnitude of the scatter distribution in the projection images. We investigate the effect that bowtie filtration has on the resulting scatter distribution in CBCT.

Methods and Materials: A CBCT Monte Carlo (MC) simulation created using an extension of the EGSnrc code is used to evaluate the changes in the scatter distribution of projection images taken with and without bowtie filtration. The bowtie filter is modeled on the F1 bowtie filter used in the Elekta XVI system. The effects of using the bowtie filter is examined for a 16.4 (head) and 30.6 cm (body) water cylinder at four different axis-to-detector distances (ADD). The effects of bowtie filtration are also simulated for three views, corresponding to rotation angles of 0, 45, and 90°, of an abdominal scan of a voxelized anthropomorphic phantom.

Results: Bowtie filtration caused a maximum percent decrease in the center pixel value of the SPR for the head and body cylinders of 12 and 29 %, respectively, at an ADD of 56 cm. The percent decrease in the SPR decreased with decreasing ADD, reducing to 7 and 19% for the head and body cylinders, respectively, at an ADD of 18 cm. The percent decrease in the SPR for the three abdominal scan views of 0, 45, and 90° when using the bowtie was 28, 27 and 18%, respectively.

Conclusion: The bowtie filter is an effective means of decreasing the magnitude and flattening out the scatter distribution. The bowtie filter is less effective in geometries with small air gaps (decreased ADD) where the magnitude of the scatter is the largest.