AbstractID: 10438 Title: Exploration of the Scatter Distribution in Cone-Beam CT using Monte Carlo Techniques

Purpose: To validate our current Monte Carlo (MC) model and explore the scatter distribution in cone-beam CT (CBCT) projection images. The MC data will be used to garner a better understanding of the relationship between imaging parameters and the resulting scatter distribution.

Method and Materials: Measured images to validate the CBCT MC model where collected using a flexible bench-top CBCT system. The x-ray tube was modeled using the BEAMnrc MC code system and the imaging geometries using a modified DOSXYZnrc program that differentiates primary from scattered particles. Two objects were investigated, a 16.4 and 30.6 cm diameter water cylinder. Projections were simulated for three different cone angles (1.4°, 5.7°, and 11.3°), three different source-to-axis distances (SAD: 50, 75, and 100 cm), and four different axis-to-detector distances (ADD: 9, 18, 30, and 56 cm). All simulations and measurements were done with an energy of 100 kVp. In order to validate the simulated scatter distributions experiments were conducted using beam-blocking techniques to estimate the scatter for a 16.4 cm and 30.6 cm water cylinder for a single geometry (SAD=100, ADD=56 cm).

Results: The simulated projections had a mean local absolute difference of 3.7 +/- 2.1% and 8.7 +/- 3.8% with the measured projections for the 16.4 and 30.6 cm diameter water cylinder respectively. Scatter simulations had a mean local absolute difference of 9.6 +/- 4.1% and 5.4 +/- 3.3% with the scatter measurements for the 16.4 cm and 30.6 cm diameter water cylinders respectively.

Conclusion: The results support the use of MC to gain a further understanding of scatter and develop new techniques to correct for scatter induced image quality artifacts in CBCT. The scatter database created will be a valuable tool in exploring the relationships between imaging geometry parameters and the scatter distribution.