AbstractID: 9219 Title: Comparison between 2D Monte Carlo modeled and experimental cone-beam CT X-ray projections

Introduction: Fast and accurate modeling of cone-beam CT (CBCT) x-ray projection data can improve cone-beam CT (CBCT) image quality either by conditioning projection data prior to image reconstruction or by supporting rigorous comparative simulation studies of competing image reconstruction and processing algorithms. In this study, we compare Monte Carlo-computed x-ray projections with projections experimentally acquired from our Varian Trilogy CBCT imaging system for phantoms of known design.

Method and Materials: Our recently developed Monte Carlo photon-transport code, PTRAN, was used to compute primary and scatter projections for cylindrical phantoms of known diameter (CatPhan and NA model 76-410) with and without bow-tie filter and antiscatter grid for both full- and half-fan geometries. The simulations were based upon measured 120 kVp spectra, beam profiles, and flat-panel detector (4030CB) point-spread functions. The beam-stop array method was used to acquire scatter and SPR distributions from the OBI images. The biasing of scatter measurements due to the long detector PSF tails was corrected either by a lead mask or by deconvolution. Computed projections were compared to flat- and dark-field corrected 4030CB images.

Results: The simulated primary profiles agree with experiment within 3%, while the simulated scatter profiles agree within 8-10%. Both PSF measurements and mask measurements indicate that scatter radiation values can be biased by as much as 7% detector PSF tails.

Conclusions: In agreement with the literature, the difference between simulated and measured projection data is of the order of 6-8%. Higher accuracy can be achieved mainly by improving the beam modeling and correcting the non linearities induced by the detector PSF.

This project was supported in part by grants from Varian Medical Systems and NCI (R01 CA 75371).