

Purpose: To develop an efficient analytical scatter correction algorithm for the On-Board Imager (OBI) for both the center-detector and offset-detector geometries used for cone-beam computed tomography (CBCT). The offset-detector geometry is used for larger transaxial field-of-views and is particularly challenging due to the asymmetric nature of the associated scatter profile and higher overall scatter-to-primary ratios.

Methods and Materials: A scatter kernel model was implemented. The cone-beam was modeled as an array of pencil beams. For each of the pencil beams, a scatter point-spread function was determined based on measured attenuation values and prior simulations of a polychromatic x-ray beam directed through uniform material. The total scatter estimate was then derived from the cumulative response of each of the scatter point-spread functions. The model also included the responses of the detector and anti-scatter grid. To test the model, a pelvis phantom and a cylindrical water phantom were imaged on a table-top system with hardware and geometric parameters that matched the OBI in offset-detector configuration. The accuracies of the estimates were determined by comparisons with experimental scatter measurements.

Results: Accuracies of the estimates were excellent away from the edges of the phantoms. Hounsfield Unit (HU) errors in the reconstructed images were reduced from over 20% pre-correction to <2% after correction in the bulk of the image. However, near the edges of the phantoms, scatter was underestimated which resulted in residual HU errors that were on the order of 10%.

Conclusions: The results demonstrate the potential for successful implementation of a computationally efficient scatter-kernel model for the OBI. Work is underway to improve scatter estimates for rays near the edges of objects.

Conflict of Interest: Employees of Varian Medical Systems.