

AbstractID: 7321 Title: Scatter Kernel Estimation and Correction with Edge-Spread-Function Method for CBCT Imaging

**Purpose:** To study the characteristics of scatter in kilo-voltage CBCT imaging, and to develop a method of reducing or removing scatter related artifacts and improve CBCT image quality.

**Methods and Materials:** The scattered radiations were modeled as depth-dependents pencil-beam kernels, which were derived using an edge-spread-function (ESF) method, for a CBCT imaging system. The ESF geometry was achieved with a half-beam block created by a 3-mm-thick lead sheet placed on top of a stack of slab solid-water phantoms. Measurements for 8 water-equivalent thicknesses (range from 0 to 41 cm) were taken with (half-blocked) and without (unblocked) the lead sheet, and corresponding pencil-beam scatter kernels or point-spread-functions (PSF), were then derived without assuming any empirical trial function. Scatter correction was incorporated into the reconstruction process to improve CBCT image quality. The process is summarized as the following: 1) The ESF was extracted from the half-blocked images; 2) The line-spread-function (LSF) of the system was calculated by taking the derivative of the ESF; 3) By assuming a symmetrical scatter kernel, the PSF was derived using a filtered-back-projection technique; 4) For thicknesses not measured, the corresponding PSF was interpolated from the measured data; 5) An iterative method was used to remove scatter from the projection image; 6) A reconstruction algorithm was applied to the scatter removed projection to derive CBCT images with improved image quality.

**Results:** The scatter kernels were successfully derived and verified with phantoms. The scatter artifacts were reduced and the image quality was improved for CBCT images incorporating the scatter removal technique. For a 32 cm-diameter uniform phantom, the flatness of reconstruction image was improved from 21.6% to 3.8%.

**Conclusion:** We developed a method to determine the scatter kernel in CBCT system and reduce the scatter related artifacts utilizing the derived kernel.

**Conflict of Interest:** Supported by Varian.