

AbstractID: 9324 Title: Image artifacts caused by the extra-focal spot of an x-ray tube in cone-beam computed tomography

Purpose: We investigate the reconstruction artifacts induced by extra-focal spot of x-ray tube in cone-beam computed tomography (CBCT)

Method and Materials: The extra-focal radiation problem of an x-ray tube has been investigated for more than thirty years. However, these investigations have been mostly limited to fan-beam computed tomography (FBCT) where only the quasi-one-dimensional source distribution matters. In contrast, CBCT is more vulnerable to the problem of extra-focal field than FBCT because the quasi-two-dimensional distribution of source is significant. Extra-focal radiation has been attributed to two physical processes: secondary electrons and field emission. Specifically, field emission of electrons from a cold cathode may create a well-defined extra-focal spot that can emit a substantial amount of x-rays. We have observed a non-negligible amount of x-ray flux from an off-focal spot in the x-ray tube of an on-board imager used for image-guided radiation therapy, and have performed a numerical study to simulate the image artifacts induced by this strong extra-focal spot. The 3-D Shepp-Logan phantom was used as an imaging object and circular cone-beam projections were made with two focal source points separated by 8 mm along the rotation axis direction. The off center focal spot had an intensity of 10% that of the central spot.

Results: We observed image artifacts such as overlaid structure of the object components in the coronal slice images and ghost objects in some transverse slice images.

Conclusion: In addition to the well-known image artifacts, due to spread extra-focal field of an x-ray tube, which include blurring of the images, well-defined extra-focal spots can introduce additional image artifacts such as overlaying structures and ghost objects.