AbstractID: 7770 Title: CT Truncation artifact removal using water-equivalent thicknesses derived from truncated projection data

Purpose: Large patient anatomies and limited imaging field-of-view (FOV) lead to truncation of CT projections. Truncation introduces serious artifacts into reconstructed images, including central cupping and bright external rings. FOV may be increased using laterally offset detectors, but this requires advanced imaging hardware and full angular scanning. When linacs equipped with mini-MLCs are used for megavoltage cone beam CT imaging, truncation is inevitable. We propose a novel method to complete truncated projections based on the observation that the thickness of the patient at all angles may be estimated along the projection rays by calculating water-equivalent thicknesses (WET). These values are not at all affected by truncation and constitute valuable auxiliary information.
Methods: We parameterize a pair of points along each ray that intersects the unknown object boundary. These points are separated by the measured WET value (obtained from projections that have been corrected for scatter and beam-hardening). We assume, for all large body parts, that the patient outline may be roughly approximated as an ellipse. We use a deterministic optimization algorithm to simultaneously estimate the point positions and ellipse parameters by minimizing the distance between point sets and the ellipse boundary. The ellipse obtained as solution is used to complete the truncated projections before reconstruction. We apply the algorithm to a severely truncated CT dataset of a typical abdomen.
Results: The RMS error between non-truncated and truncated reconstructions is 176%. The correction algorithm reduces this error to 1.0%.
Conclusion: Even thought the algorithm assumes an elliptical patient cross-section, truly impressive increases in quantitative image quality are observed. The presence of pelvic bone in the image does not appreciably bias the ellipse position even though it produces incorrect thickness estimates for some rays. The algorithm incurs low computational burden and is suitable for on-line clinical work flows. Supported by Siemens.