AbstractID: 3891 Title: Cone-beam image reconstruction for circular-arc trajectories via shift-invariant horizontal and non-horizontal filtering

Purpose: To propose and validate a novel shift-invariant filtered backprojection (FBP) type cone-beam reconstruction algorithm for circular-arc scanning trajectories. This algorithm has been proposed to address two shortcomings in the FDK algorithm; namely, limited visibility of low contrast objects in the off-center planes and the inability to provide clinically acceptable reconstruction when the scanning path is shorter than the short-scan condition.

Methods: Based upon the application of an exact cone-beam reconstruction algorithm to the case of a circular trajectory, which does not fulfill the Tuy data sufficiency condition, a new algorithm has been developed. The new algorithm differs from the heuristic FDK algorithm in that multiple sets of filtered data are utilized in reconstructing the value of a single image point. The new algorithm introduces non-horizontal filtering which is not achievable by heuristic extension fan-beam FBP reconstruction. In this manner more of the cone-beam data is utilized in the filtering operation. The new algorithm also enables region-of-interest (ROI) reconstruction in a super-short scan mode (less than the short-scan angular range).

Results: Computer simulations were performed using analytical data generated for a standard low contrast phantom. The new algorithm provided improved visualization of structures that lie in off-center planes when compared with the FDK algorithm. In addition simulations were performed to validate the ROI reconstruction using a super-short scan mode.

Conclusions:
The circular-arc scanning trajectories are used frequently in cone-beam CT on interventional C-Arm systems, micro CT systems and cone-beam CT guided radiation therapy. A new shift-invariant FBP type cone-beam reconstruction algorithm has been proposed and validated for this common source trajectory. In comparison with the standard FDK algorithm the new algorithm provides improved visualization of structures that lie in off-center planes, and it enables a super-short scan mode for ROI reconstruction.