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"Iterative image reconstruction algorithm for Tetrahedron Beam Computed Tomography (TBCT)"

Purpose: Tetrahedron Beam Computed Tomography (TBCT) circumvents some problems of cone beam CT (CBCT) such as excessive scatter and suboptimal detector performance but still shares the same approximate cone reconstruction artifacts that result from using the FDK algorithm. Iterative reconstruction algorithms have recently begun to be widely employed in diagnostic CT scanners in order to suppress noise and reduce imaging dose. In this study, we developed an iterative TBCT image reconstruction algorithm which is able to mitigate the cone beam reconstruction artifact as well as reduce image noise.

Material and Methods: For this study, the simultaneous algebraic reconstruction technique (SART) algorithm was employed as our iterative reconstruction algorithm. The projection matrix was calculated using a distance driven method. The developed algorithms were tested using both projections calculated from numerical phantoms and projections collected by the TBCT system using a physical phantom. Noise levels in reconstructed images were quantified, and the approximate image reconstruction artifact at larger cone angles was evaluated.

Results: The SART algorithm was able to reconstruct the noiseless phantom data comparably to the FDK algorithm. With noisy data, the iterative method was able to reduce noise levels 16-20% in regions throughout the images compared to the FDK method. Using both numerical and real projection data from our TBCT benchtop system, the SART algorithm was able to maintain a spatial resolution similar to the FDK algorithm. The cone artifact was also significantly reduced.

Conclusions: By suppressing noise and reducing the cone reconstruction artifact, the iterative SART algorithm further improves the image quality of the TBCT system. Due to its scatter rejection geometry and the use of high quality CT detectors, TBCT can achieve image quality very close to that of diagnostic CT.

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