Evaluation of two-pass view aliasing artifact suppression algorithm using clinical data

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Purpose: In brain perfusion CT imaging, state-of-the-art C-arm CT systems can rotate up to 100 degrees / second, which permits CT imaging with high temporal resolution. However, the read-out rate of the flat panel detector often limits the number of projections acquired in the fast scan and causes view aliasing artifacts in the reconstruction. We propose to suppress aliasing artifacts in decomposed projections through feature preserving interpolation.

Methods: The high frequency structures that cause streak artifacts are hidden within the total line integral. Thus, the interpolation-based method for angular up-sampling often fails to correct for these high frequency structures. We propose an FBP-based algorithm using multi-resolution reconstruction to identify the structures in projection space that may cause the artifacts. The adaptive multi-resolution FDK reconstruction adaptively selects the bandwidth of the ramp filter in the FDK method to reconstruct regions of the image at maximal frequency without view aliasing artifacts. A feature preserving interpolation in projection space is used to increase the angular sampling rate. The restored high frequency structures are then added back to the view aliasing-free reconstruction. The proposed method's performance is assessed using real patient C-arm (Artis zee biplane system, Siemens AG, Germany) head scan data. Only 124 out of 248 projections are used for the reconstruction to mimic the sparse-view data in the fast scan. Our results are compared to those with and without linear interpolation method.

Results: As shown in Figure 1, the proposed method can effectively reduce the view aliasing streak artifacts. The structural similarity (SSIM) indices of the brain tissue region using the FDK, linear interpolation, and proposed methods comparing to the ground truth are 0.7428, 0.7686 and 0.8060, respectively. The proposed method also reduces the standard deviation of the brain tissue without contrast (which is assumed to be uniform) from 56.2 HU to 35.7 HU while the linear interpolation method has a standard deviation of 42.5 HU. The proposed method is compatible with a projection-based motion compensation technique to further improve the image quality.

Conclusion: Distinct from other blurring-based and iterative reconstruction methods, our method maximally preserves image spatial resolution with only two iterations. Future investigations will incorporate the technique for noise reduction and compare to sparse view iterative reconstruction.

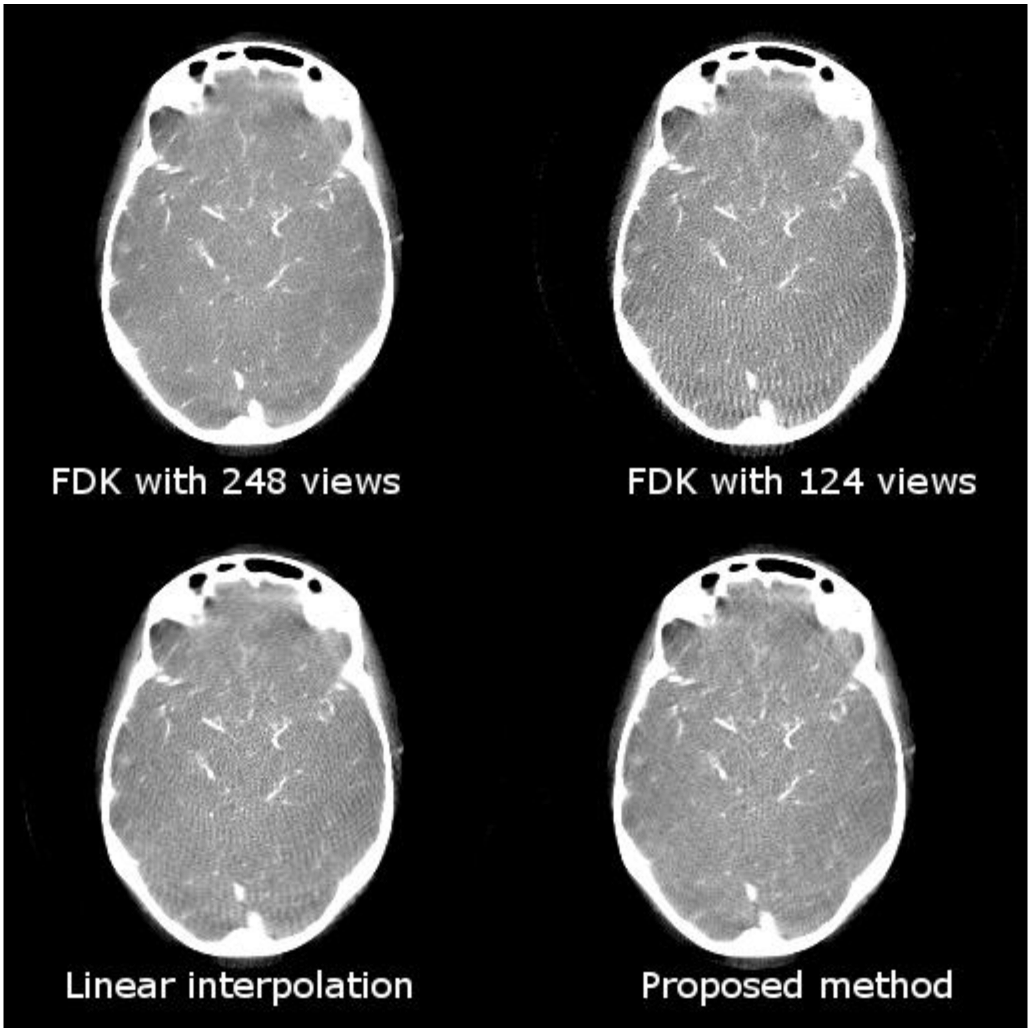

Figure 1, reconstruction results using FDK, linear interpolation and the proposed method. The display window is [-500 500] HU.