Purpose:Multi-slice helical CT has been widely used in CT diagnostic imaging due to its large coverage and short acquisition time. However, the associated high x-ray radiation dose has become a major concern. Two straightforward ways to reduce the dose is to lower the mAs level and use high pitch. Yet, the traditional linear interpolation (LI) based filtered backprojection (FBP) reconstruction method leads to highly degraded images containing obvious image noise and ring artifacts around the edges under these situations. The aim of this work is to propose a novel iterative reconstruction algorithm for low dose helical CT.

Methods:In our method, the helical scanning geometry and the cone angle in the multi-slice CT are accurately modeled by proper computation of the forward projection matrix. CT images are reconstructed by minimizing a cost function consisting of a data fidelity term and a regularization term which requires that the solution has a sparse representation under a piecewise linear Tight-frame (TF) basis. We tested our algorithm on a digital NCAT phantom at thorax region with two different high pitches (2:1 and 2.5:1) and low mAs level. The conventional LI-based FBP algorithm was also studied for comparison purposes.

Results:The CT images reconstructed by LI-based FBP method contain obvious noise and ring artifacts around the edges, while the images by our TF-based method show better quality with less noise and smooth edges. Compared with the LI-based FBP method, our method enhances the signal-to-noise ratio by a factor of about 3.5 and also leads to higher edge cross-correlation coefficients.

Conclusions:The TF-based iterative reconstruction algorithm outperforms the LI-based FBP method in effectively removing the image noise due to low mAs level and ring artifacts of edges due to high pitches in the cases studied, demonstrating its promising applications for helical CT reconstruction.