On A Fast Denoising Technique in Tomography

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Abstract. A fast denoising approach in spectral tomography is investigated. At each iteration step of image reconstruction, total variation is estimated on a longitudinal subdomains of multispectral image. Results of numerical comparative reconstructions are illustrated.

The development of spectral computerized tomography (CT) has made substantial progress in recent years especially in applying the optimization theory methods for reconstruction from few-views CT data [1]. However, acceleration of convergence of iterative algorithms is still an important problem. For approaching this issue, joint image reconstruction and segmentation has already attracted interest of mathematicians [2]. In this work, we are concentrated on a modular approach, where segmentation is implemented and controlled separately to keep the algorithm fast.

During a reconstruction procedure, a subset of voxels of the image under reconstruction along the x-ray penetration domain constitutes a one-dimensional staircase-like strip, or elongated patch, intersecting the image. Total variation (TV) denoising can be applied to this patch in 1-D mode very fast [3]. Considering a certain strip-like subdomain of length M voxels for all K different channels, we obtain an $M \times K$- sized image S. We apply then statistical techniques to segment the image S, detect points of simultaneous change in the rows of image S which indicate the image edges. The segmented patch serves as an input for the next iteration step of the algorithm used for spectral CT in combination with TV regularization.

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References

1. Zhang, Y. et al: Spectral CT Reconstruction With Image Sparsity and Spectral Mean. IEEE Trans. on Comput. Imaging. 2, 510–523 (2016)
2. Storath, M. et al: Joint image reconstruction and segmentation using the Potts model. Inverse Problems. 31, (025003) (2015)
3. Condat, L.: A Direct Algorithm for 1-D Total Variation Denoising. IEEE Signal Processing Letters. 20, 1054–1057 (2013)