AbstractID: 13836 Title: CT Reconstruction from Undersampled Projection Data via Edge-preserving Total Variation Regularization

Purpose: High radiation dose in CT scans increases a lifetime risk of cancer and is always a major concern. Recently, iterative reconstruction algorithm with Total Variation (TV) regularization has been developed to reconstruct CT images from highly undersampled data in order to reduce the imaging dose. Nonetheless, CT images reconstructed in this approach are sometimes over-smoothed and edge information is lost. In this work, we developed an iterative CT reconstruction algorithm with edge preserving TV regularization to accurately reconstruct CT images from highly undersampled data. **Methods and Material:** The CT image is reconstructed by minimizing TV norm under a constraint posed by few X-ray projections. To avoid over-smoothed edge, an edge-preserving penalty was proposed and added to the TV norm. We tested our reconstruction algorithm on 4 cases, namely, Shepp-Logan head phantom, NCAT phantom at thorax region, a real patient head case and a real patient lung case. The reconstruction accuracy was evaluated using relative error and edge correlation coefficient. Conventional FDK filtered backprojection algorithm and conventional TV regularization method without edge preserving term were also studied for comparison purpose. **Results:** It is found that 30 equi-angle projections are enough for reconstructing the CT images in phantom experiments and 40 projections for real patient experiments. Our approach outperforms the FDK algorithm and the conventional TV algorithm in terms of the relative error and the edge correlation coefficient in all the four test cases. In particular, the reconstructed images using our approach contain less noise and sharp edges. **Conclusion:** The edge-preserving TV performs better in CT images reconstruction. About 30~40 X-ray projections are enough to accurately reconstruct the CT images, which implies a potential radiation dose reduction by about 20 times.