Joint image reconstruction method with correlative multi-channel prior for x-ray spectral computed tomography - DTU Orbit (16/12/2018)

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Rapid developments in photon-counting and energy-discriminating detectors have the potential to provide an additional spectral dimension to conventional x-ray grayscale imaging. Reconstructed spectroscopic tomographic data can be used to distinguish individual materials by characteristic absorption peaks. The acquired energy-binned data, however, suffer from low signal-to-noise ratio, acquisition artifacts, and frequently angular undersampled conditions. New regularized iterative reconstruction methods have the potential to produce higher quality images and since energy channels are mutually correlated it can be advantageous to exploit this additional knowledge. In this paper, we propose a novel method which jointly reconstructs all energy channels while imposing a strong structural correlation. The core of the proposed algorithm is to employ a variational framework of parallel level sets to encourage joint smoothing directions. In particular, the method selects reference channels from which to propagate structure in an adaptive and stochastic way while preferring channels with a high data signal-to-noise ratio. The method is compared with current state-of-the-art multi-channel reconstruction techniques including channel-wise total variation and correlative total nuclear variation regularization. Realistic simulation experiments demonstrate the performance improvements achievable by using correlative regularization methods.

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