

Proximal iterative hard thresholding methods for wavelet frame based image restoration

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Abstract: The iterative (both soft and hard) thresholding algorithms were primarily proposed for wavelet based linear inverse problems, especially image restoration problems with sparsity constraint. The analysis of iterative soft thresholding algorithms has been well studied under the framework of forward-backward splitting method and inspired much of the work for different applications and related minimization problems. However, iterative hard thresholding methods are less understood due to its non-convexity and discontinuity, although there are some studies related to sparse signal recovery and image restoration. We consider the ℓ_0 -norm regularized wavelet frame balanced approach for image restoration. In particular, we study the convergence and convergence rate of two algorithms, namely proximal iterative hard thresholding (PIHT) algorithm and extrapolated proximal iterative hard thresholding (EPIHT) algorithm for solving general optimization problems. Finally, we conduct numerical experiments on sparse signal reconstruction using compressive sensing, and wavelet frame based image restoration problems to demonstrate the improvement of ℓ_0 -norm based regularization models as well as the effectiveness of the proposed algorithms compared with some prevailing models and algorithms.