

**FAST MULTI-LEVEL RECONSTRUCTION OF BIOMEDICAL IMAGES USING WAVELET SPARSITY CONSTRAINTS****Michael Unser<sup>1</sup>, Cédric Vonesch<sup>1</sup>, Matthieu Guerquin-Kern<sup>1</sup> and Dimitri Van De Ville<sup>1,2</sup>**<sup>1</sup>Biomedical Imaging Group, EPFL, Switzerland<sup>2</sup>University Hospital Geneva, Switzerland

Wavelet-domain  $\ell_1$ -regularization is a powerful approach for solving inverse problems. In their 2004 landmark paper, Daubechies et al. proved that one could solve such linear inverse problems by means of a “thresholded Landweber” (TL) algorithm [1]. While this iterative procedure is simple to implement, it is known to converge slowly. Here, we present a multilevel version of the algorithm that is inspired from the multigrid techniques used for solving PDEs, but with one important difference : instead of cycling through coarser versions of the problem (REDUCE part of multigrid), the multilevel algorithm cycles through the successive wavelet subspaces. The method works with arbitrary wavelet representations ; it typically yields a 10-fold speed increase over the standard TL algorithm, while providing the same restoration quality. We illustrate the applicability of the method to three biomedical image reconstruction problems : the deconvolution of 3D fluorescence micrographs [2], the global reconstruction of dynamic PET from time measurements [3], and the reconstruction of magnetic resonance images from arbitrary (non-uniform)  $k$ -space trajectories. We present experimental results with real data sets in all three cases.

**References**

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