**Reconstruction of Sparse Signals and Compressively Sampled Images Based on Smooth l1-Norm Approximation**

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## Abstract

Sparse signal reconstruction methods are used in a wide range of applications such as compressive sensing, denoising, signal separation and general linear inverse problems. The numerical algorithms used for the sparse signal recovery frequently involve finding solutions to the least squares optimization problem with l1-norm regularization. As the l1-norm penalty is not differentiable, so it rules out the possibility of using the efficient optimization techniques that call for the derivative of the objective function. This paper presents a hyperbolic tangent based surrogate function to closely approximate the l1-norm regularization. Simultaneously, we also develop an iterative algorithm for sparse signal reconstruction using the gradient of the proposed smooth function. The algorithm can be used to recover the compressively sampled images from a reduced set of measurements. Various numerical and imaging experiments are used to illustrate the performance of the promising recovery method. It has been shown that the algorithm can be used to reconstruct the compressively sampled images from less number of acquired data, which makes fast imaging possible without compromising high spatial resolutions. The results are validated using phantom as well as original MR and microwave SAR images. © 2016 Springer Science+Business Media New York

## Author keywords

Compressive sampling; Hyperbolic tangent based approximations; Imaging and sensing; l1-norm; Sparse representation

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