Approximation and Optimization in Image Restoration and Reconstruction
Ile de Porquerolles, France
June 8–12, 2009

UNSUPERVISED WAVELET-BASED REGULARIZATION IN PARALLEL MRI RECONSTRUCTION

L. Chaâri[1,2], J.-C. Pesquet[1], P. Ciuciu[2] and A. Benazza-Benyahia[3]

[1] Université Paris-Est, IGM and UMR CNRS 8049,
77454 Marne-la-Vallée cedex, France
[2] NeuroSpin/CEA, 91191 Gif-sur-Yvette cedex
[3] URISA, SUP'COM, Cité Technologiques des Télécommunications, 2083, Tunisia

Since the 1990-s, parallel Magnetic Resonance Imaging (pMRI) has emerged as a powerful 3D imaging technique for reducing scanning time. To speed up acquisition, the acquired k-space is sampled R times under the Nyquist rate. Full Field of View images are then reconstructed from the aliased data acquired along complementary coils, by applying for instance the Sensitivity Encoding (SENSE) algorithm [1]. However, SENSE-based reconstructed images suffer from several artifacts because of noise and inaccurate coil sensitivity profiles. The inverse pMRI reconstruction problem being ill-conditioned, regularization tools allowed us to obtain a significant enhancement of the reconstructed image quality even at high reduction factors (e.g. $R = 4$) and low magnetic field (1.5 Tesla) [2,3]. In this talk, we summarize our recent advances for regularizing the pMRI reconstruction in the Wavelet Transform (WT) domain, which gives access to sparse image representations. Here, a special attention has to be paid about the regularization model since the data and the unknown image are complex-valued. Several penalty functions, which assume independence or not between real and imaginary parts of the wavelet coefficients, have been successively tested. On human brain data, we illustrate how the proposed regularization scheme enhances image reconstruction in comparison to other existing techniques.

References

[1] K. P. Pruessmann, M. Weiger, M. B. Scheidegger, and P. Boesiger, SENSE : sensitivity encoding for fast MRI, *Magn. Res. in Med.,* **42** (1999) 952–962.

[2] B. Liu, L. Ying, M. Steckner, X. Jun, and J. Sheng, Regularized SENSE reconstruction using iteratively refined total variation method, *ISBI,* (2007) 121–124.

[3] L. Chaâri, J.-C. Pesquet, A. Benazza-Benyahia, and Ph. Ciuciu, Autocalibrated parallel MRI reconstruction in the wavelet domain, *ISBI,* (2008) 756–759.