EXPLOITING COMPRESSIVE SENSING FOR NON LINEAR INVERSE SCATTERING

Martina Bevacqua[(1)], Lorenzo Crocco[(2)], Loreto di Donato[(3)], Tommaso Isernia[(1,2)]
(1) DIIES Università Mediterranea di Reggio Calabria, Reggio Calabria, Italy.
(2) Istituto per il Rilevamento Elettromagnetico dell'Ambiente IREA-CNR, Napoli, Italy.
(3) DIEEI, Università degli Studi di Catania, Catania, Italy.

Compressive Sensing is a powerful paradigm, which has recently emerged as a way to recover 'sparse' signals, i.e. signals where it is known that only a few coefficients of a given representation (whose indices are not known) are different from zero. Provided given conditions are fulfilled amongst the original cardinality of the unknown signal, the number of elements different from zero, and the number of independent measurements, CS theory provides theoretical results and numerical procedures such to guarantee a faithful recovery of the unknown signal.

The CS paradigm is of course of interest in inverse scattering, as in a number of situations (non destructive testing, imaging of man-made objects, differential imaging, contrast aided biomedical imaging, just to name a few) the unknown contrast function can be considered to be sparse in some suitable basis.

Unfortunately, CS has only been developed for the case of linear problems, whereas inverse scattering problems, (in the lack of a priori information such to guarantee possible linearizations), is instead a non linear problem, so that theoretical results and practical tools available from the large CS literature cannot be directly applied.

In this communication, we report our first results about the possible application of CS tools and procedures to non linear inverse scattering problems. In particular, we report about two different strategies we have tested, all in conjunction with Contrast Source based [P. M. van den Berg and R. E. Kleinman, *Inv. Prob.*, **13**, 1997, pp. 1607–1620; M. D'Urso, T. Isernia, and A. Morabito, *IEEE Trans. Geosci. Remote Sens.*, **48**, 2010, pp.1186–1198] inversion techniques, for enforcing sparsity, i.e.:

- The exploitation of strict bounds on the space search while looking for a minimization of the cost functional defined in [P. M. van den Berg and R. E. Kleinman, *Inv. Prob.*, **13**, 1997, pp. 1607–1620];
- The insertion of an additional penalty term enforcing sparsity in the same functional as above.

Also, a number of different penalty term and different kind of sparsity (i.e. in domains other than the pixel based such as wavelet and sparse in the gradient) have been tested and optimized.

The outcomes of such an extensive analysis, all suggesting to pursue the second general strategy, will be reported at the Conference.