Quantitative Inverse Scattering with Sparseness Constraints - the Compressive Sensing paradigm

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Abstract

Quantitative imaging techniques are aimed at evaluating the dielectric properties of targets located in inaccessible investigation domains by illuminating the scenario with a set of interrogating waves and by processing the resulting re- irradiated fields. These methodologies have important applications in biomedical diagnostics, non-destructive testing, remote sensing, and subsurface prospecting. Unfortunately, because of the theoretical properties of the associated inversion problems, the development of fast, and robust general-purpose numerical methods for quantitative imaging is still an open challenge.

The introduction of a-priori information in terms of regularization terms within the inversion process has been proposed as an effective approach to handle quantitative imaging problems. More specifically, Compressive Sensing (CS) has emerged as one of the most promising paradigms for the development of effective inversion methodologies for quantitative imaging. CS techniques essentially exploit the fact that the data (e.g., the scattered field) is linearly related to the unknowns (e.g., the equivalent sources or the contrast), and that these unknowns have a (direct or indirect) sparse representation in a suitable domain. This contribution is aimed at reviewing some of the most advanced CS imaging methodologies, and at envisaging some of the ongoing research activities aimed at addressing current limitations and drawbacks.

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