1 Block splitting least square regularization for structured matrices arising in nonlinear microwave imaging

By *Claudio Estatico*.

Nonlinear inverse problems arising in a lot of real applications generally leads to very large scaled and structured matrices, which require a wide analysis in order to reduce the numerical complexity, both in time and space. Since these problems are ill-posed, any solving strategy based on linearization involves a some least square regularization. In this talk a microwave imaging problem is introduced: the dielectric properties of an object under test (i.e., the output image to restore) are retrieved by means of its scattered microwave electromagnetic field (i.e., the input data). By a theoretical point of view, the mathematical model is a nonlinear integral equation with structured shift variant integral kernel. By a numerical point of view, the linearization and discretization gives rise to an ill-conditioned block arrow matrix with structured blocks, which is iteratively solved by a three-level regularizing Inexact-Newton scheme as follows: (*i*) the first (outer) level of iterations is related to a least square Gauss-Newton linearization; the second level of iterations is related to a block splitting iterative scheme; (*iii*) the third and nested inner level of iterations is related to a regularization iterative method for any system block arising from any level II iteration. After that, post-processing techniques based on linear super-resolution improves the quality of the results, and some numerical results are given and compared.
This is a joint work with Professor J. Nagy of the Emory University, Atlanta, and Professors F. Di Benedetto, M. Pastorino, A. Randazzo and G. Bozza, of the University of Genova, Italy.

Bibliography

C. Estatico, G. Bozza, A. Massa, M. Pastorino, A. Randazzo,
"A two steps inexact-Newton method for electromagnetic imaging of dielectric structures from real data", *Inverse Problems*, **21**, pp. S81–S94, 2005.
C. Estatico, G. Bozza, M. Pastorino, A. Randazzo,
"An Inexact-Newton method for microwave reconstruction of strong scatterers", *IEEE Antennas and Wireless Propagation Letters*, **5**, pp. 61-64, 2006.

F. Di Benedetto, C. Estatico, J. Nagy,
"Numerical linear algebra for nonlinear microwave imaging", *in preparation.*