The 7th International Conference "Inverse Problems: Modeling and Simulation"(IPMS-2014)
Fethiye, Turkey, May 26 - 31, 2014

Approximate Global Convergence for Coefficient Inverse Problems

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ABSTRACT

Coefficient Inverse Problems (CIPs) are both non-linear and ill-posed. Therefore, the development of such numerical methods, which would converge to exact solutions without any a priori knowledge of any points in small neighborhoods of those solutions is an important goal. We call this type of algorithms "globally convergent". Indeed, the main ingredient for any conventional locally convergent technique (e.g., gradient or Newton method) is the knowledge of at least one point in a small neighborhood of the solution. However, such a knowledge is rare in applications.

We consider only the most difficult case of a single measurement, i.e. the time resolved data are generated either by a single point source or by a single direction of the incident plane wave. These data are non-redundant ones.

Because the problem of the development of globally convergent algorithms for CIPs is an enormously challenging one, we use an approximation [1]. This approximation is a very mild one: we truncate a certain WKB-like asymptotic series, which is similar with the geometrical optics. That approximation is used only on the first iteration of our procedure. Given this approximation, we rigorously prove that our method provides several points in a small neighborhood of the exact coefficient without any advanced knowledge of that neighborhood. Because of that approximation, we call our technique "approximately globally convergent". Next, to refince the solution, one can apply any locally convergent technique, whose starting point would be the one obtained by our method [1].

The ultimate verification of any numerical method for an inverse problem lies in verification on experimental data, especially in the unbiased case of blind data. Numerical results for blind backscattering experimental data will be presented. These time resolved data were collected by an experimental device, which was assembled in University of North Carolina at Charlotte.

REFERENCE

1. L. Beilina and M.V. Klibanov, *Approximate Global Convergence and Adaptivity for Coefficient Inverse Problems*, Springer, 2012.