Dirichlet-to-Neumann map and direct numerical methods in inverse multidimensional hyperbolic problems

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We consider dynamical type of inverse problems in which the additional information is given by the trace of the direct problem solution on a (usually time-like) surface of the domain. This kind of inverse problems were originally formulated and investigated by M. M. Lavrentiev and V. G. Romanov (1966).

A majority of the papers and books devoted to numerical study of dynamic inverse problems deal with one of the following basic methods:

- the method of Volterra operator equations;
- Linearization and Newton-Kantorovich method;
- Landweber iterations and optimization;
- the Gelfand-Levitan-Krein and boundary control methods;
- the method of finite-difference scheme inversion.

The first group of methods, namely, Volterra operator equations, Newton-Kantorovich, Landweber iteration and optimization produce the iterative algorithms in which one should solve the corresponding direct (forward) problem and adjoint (or linear inverse) problem on every step of the iterative process. On the contrary, the Gelfand-Levitan method, the method of boundary control, the finite-difference scheme inversion and sometimes linearization method do not use the multiple direct problem solution and allow one to find the solution in a specific point of the medium. Therefore we will refer to these methods as the "direct" methods. In the present talk we will discuss theoretical and numerical background of Gelfand-Levitan, Dirichlet-to-Neumann map and boundary control methods.

We will formulate and prove theorems of convergence, conditional stability and other properties of the mentioned above methods.

References

1. Kabanikhin, S. I., Satybaev, A. D. and Shishlenin, M. A. *Direct Methods of Solving Inverse Hyperbolc Problems.* VSP, Utrecht, 2004.

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