Vladikavkaz Scientific Center of the Russian Academy of Sciences

North Caucasus Center for Mathematical Research
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International Seminar
"Operator Theory, Differential Equations and their Applications"

Seminar Chairmen: Prof. Anatoly G. Kusraev, Prof. Marat A. Pliev
Seminar Secretary: PhD Batradz B. Tasoev

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Geometric and coefficient inverse two-dimensional problems of the elasticity theory for semi-bounded regions

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Research is devoted to the investigation of two important classes of inverse problems for inhomogeneous planar and cylindrical waveguides.

The first class is the inverse geometric problems related to the identification of defects in bodies based on acoustic sounding data. In the framework of the dissertation research, an effective scheme for solving the problem of identifying a curvilinear crack of small relative size in a layer has been proposed. The proposed technique is based on the asymptotic analysis of wave fields and the construction of simplified solutions of boundary integral equations concerning the functions of crack opening. The solution of the identification problem is reduced to sequential determination of the defect parameters by their simple relations according to the data on the amplitude values of displacement fields measured at the part of the layer upper bound. The proposed method has been tested on model problems for an orthotropic layer with a rectilinear and curvilinear crack, a combined layer with a crack on the interface of half-layers, a layer with a delamination on the lower boundary. A numerical analysis of the identification problem has been performed, as a result of which the working ranges of the proposed asymptotic approach have been revealed from a comparison analysis of the results obtained by the boundary element method.

The second class of the investigated problems is related to an important class of inverse coefficient problems (ICP) focused on reconstruction of laws of inhomogeneities of plane and cylindrical waveguides. A general scheme for the study of ICP is proposed, which is based on

the division of the original two-dimensional problems into subgroups of simpler one-dimensional problems with respect to the averaged characteristics and moments of different orders of the displacement vector components, in which the restored functions are separated. To solve each of the subproblems, iterative processes are constructed, at each step of which the Fredholm integral equations of the 1st and 2nd kind are solved. Based on the proposed scheme, model problems are solved for the reconstruction of the inhomogeneous properties of planar orthotropic elastic and viscoelastic waveguides, and for the cylindrical elastic and viscoelastic isotropic waveguides using data on the displacement fields measured at the outer bound of the waveguide. Computational experiments for different laws of change in mechanical properties have been carried out, and the experimental results suggest a high efficiency of the proposed approach.

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