A New Non-Iterative Reconstruction Method for Solving a Class of Geometrical Inverse Problems

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Several classes of inverse reconstruction problems are written in the form of over-determined boundary value problems. The general idea consists in rewriting them as an optimization problem. In particular, we are interested in the reconstruction of the support of a set of hidden anomalies embedded into a geometrical domain from partial boundary measurements. Therefore, a shape functional measuring the misfit of the solution obtained from the model and the data taken from the measurements is minimized with respect to a set of ball-shaped anomalies by using the topological derivative method. It means that the shape functional is expanded asymptotically and then truncated up to the desired order term. The resulting expression is trivially minimized with respect to the parameters under consideration, leading to a non-iterative second order reconstruction algorithm. As a result, the reconstruction process becomes very robust with respect to noisy data and independent of any initial guess.