FOREWORD

The theory of ill-posed problems, whose fundamentals were developed by Academician A. N. Tikhonov and some other prominent Soviet mathematicians, is rather new but thriving direction in computational mathematics. Permanent interest to its results can be ascribed primarily to its continuously extending sphere of applications to quite different fields of science and technology and to advances in computer science.

Inverse problems, that require determination of a set of causal characteristics from measurements of a system or a process state, present the widest range of application of the ill- posed problem theory. The disturbance of the natural cause-effect relations results in ill-posedness of inverse problems. Many problems of mathematical model identification are ill-posed. They are to be also used in the cases when required characteristics of the process studied are inaccessible for direct observation.

Effective methods developed for solving inverse problems have allowed researchers to simplify considerably experiments, to increase the accuracy and the confidence of results obtained by a certain complication of algorithms for experimental data processing. The part of work done by a computer increases more and more and that reduces time and cost of experimental studies and facilitates their further computerization.

In view of the above, development of effective methods for solving ill-posed problems and computational algorithms for specific applied problems is now of great interest.

This monograph is based on the authors' studies carried out to investigate one of the most promising trends in the theory of ill-posed problems, namely, iterative regularization and its application to inverse heat transfer problems. The studies have been conducted effectively at Moscow Aviation Institute by a group of researchers directed by Prof. O. M. Alifanov. He has obtained important results in methodology of solution of ill-posed inverse heat transfer problems and it was he who suggested the iterative regularization method. Efficiency and simplicity of the algorithms and versatility of the iterative regularization method enhanced the development and implementation of the method in practice as well as expansion of classes of the problems which can be solved by the use of this method. The authors consistently discuss a broad range of problems concerned with both the theory of regularizing gradient algorithms and peculiarities of their application to the most often encountered inverse problems of reconstruction of external heat fluxes and the identification of mathematical models for heat transfer processes. Great attention is paid to the synthesis of effective computational algorithms, including calculation of the residual gradient and including apriori information on the desired solution. The ways of increasing the data accuracy by optimal experimental design are considered. The discussion is exampified by results of model experiments that show high efficiency of the algorithms suggested for a wide class of inverse problems.

Undoubtedly, the book may be of interest for both researches of the theory of ill-posed problems and those interested in its applications to inverse heat transfer problems.

V. A. Mel'nikov