

Preface

In this volume are collected some of articles related to the workshop “Third Annual Workshop on Inverse Problems” which was organized within the project “Adaptive Finite Element Methods for Solutions of Inverse Problems”. For the full information about the project visit the project site <https://sites.google.com/site/visby2010/>.

This workshop was supported by the Swedish Institute, Visby program, and took place from May 2 to 6, 2013 in Stockholm, Sweden.

All chapters in this volume highlight the most recent research related to the new reliable numerical methods for the solution of inverse and ill-posed problems. The importance of these problems is due to a wide range of applications, such as, e.g., development of new materials with desired values of parameters, many aspects of acoustics, electromagnetics, optical fibers, medical imaging, geophysics, determination of parameters in physico-chemical systems, etc. Construction of new reliable methods for solution of coefficient inverse problems is a very challenging task and some recent results in this area are presented in this volume.

Investigation of a class of regularized Gauss–Newton type methods for the solution of irregular nonlinear equations with general smooth operators in a Hilbert space is considered in the chapter by Mikhail Yu. Kokurin and Anatoly B. Bakushinsky. Authors analyze two qualitatively different schemes of generation of stochastic data, establish approximation properties of the methods and prove accuracy estimates. Approximately globally convergent and adaptive finite element methods for reconstruction of shapes and refractive indices of objects placed in the air from experimental data are presented in the chapter by L. Beilina, Nguyen Trung Thanh, Michael V. Klibanov, and John Bondestam Malmberg. Experimental data for this work were collected using a microwave scattering facility which was built at the University of North Carolina at Charlotte, USA. Authors briefly describe and present new results for both methods. In the chapter by John Bondestam Malmberg is considered an inverse problem of determination of a dielectric permittivity function from a backscattered electromagnetic wave measurements. Author presents the method for the solution of this inverse problem and provides an a posteriori error estimate in the Lagrangian setting. In the work by E. Karchevskii, A. Spiridonov and L. Beilina is presented a new method for determination of dielectric permittivity constant using measurements of the propagation constant of the fundamental mode in optical

fiber's. Eigenmodes of linearised problems of scattering in the frequency domain and generation of oscillations on cubically polarisable layers are presented in the work by Lutz Angermann, Yuri V. Shestopalov, and Vasyi V. Yatsyk. In the chapter by Soheil Soltani, Ronnie Andersson, and Bengt Andersson an optimization method for computation of deconvolution of concentration measurements has been proposed. In this work the generalized discrepancy principle is used to calculate the regularization parameter. The developed algorithm has been successfully tested on both synthetic and experimental datasets and can be adapted to other laboratory reactor systems to enhance the time resolution of time-dependent experiments. An algorithm for the reconstruction of two constant complex dielectrics in a cylindrical waveguide using frequency domain measurements is presented in the chapter by L. Beilina and A. Eriksson. In the chapter by L. Beilina and I. Gainova is proposed a time-adaptive finite element method for the solution of a parameter identification problem for system of Ordinary Differential Equations (ODE) which describes dynamics of primary human immunodeficiency virus (HIV) infection using drug therapy. In the work by L. Beilina and E. Karchevskii is presented a new model of an approximate globally convergent method in a frequency domain for reconstruction of dielectric permittivity function in a weakly guiding optical fiber. The conjugate gradient method is used in the chapter by L. Beilina, M. Cristofol, and K. Niinimäki for the solution of an inverse problem for simultaneous reconstruction of the dielectric permittivity and magnetic permeability functions of the Maxwell's system in 3D using backscattering data. Finally, N. Koshev in his work considers methods of solution of forward and inverse problems of voltammetry.

We can note that as one of the book features in many articles, a reader finds the whole description of used numerical method, from problem statement to numerical results. The intended audience of the book is: university students (knowledge of mathematics: Bachelor level and higher), PhD students (specializing in applied mathematics, mathematics, electrical engineering, physics), Dr. Sci, researchers, university teachers, R&D engineers, and electrical engineers with deeper knowledge and interest in mathematics.

Inverse Problems and Applications

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