A.B. Bakushinsky and M. Yu. Kokurin

Iterative Methods for Approximate Solution of Inverse Problems

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Vyacheslav Vikhrenko

Iterative Methods For Approximate Solution Of Inverse Problems:

Iterative Methods for Approximate Solution of Inverse Problems A. B. Bakushinsky,M. Yu. Kokurin,2014-09-01

Iterative Methods for Approximate Solution of Inverse Problems A.B. Bakushinsky,M.Yu. Kokurin,2007-09-28 This volume presents a unified approach to constructing iterative methods for solving irregular operator equations and provides rigorous theoretical analysis for several classes of these methods The analysis of methods includes convergence theorems as well as necessary and sufficient conditions for their convergence at a given rate The principal groups of methods studied in the book are iterative processes based on the technique of universal linear approximations stable gradient type processes and methods of stable continuous approximations Compared to existing monographs and textbooks on ill posed problems the main distinguishing feature of the presented approach is that it doesn t require any structural conditions on equations under consideration except for standard smoothness conditions This allows to obtain in a uniform style stable iterative methods applicable to wide classes of nonlinear inverse problems Practical efficiency of suggested algorithms is illustrated in application to inverse problems of potential theory and acoustic scattering The volume can be read by anyone with a basic knowledge of functional analysis The book will be of interest to applied mathematicians and specialists in mathematical modeling and inverse problems **Numerical Methods for Solving Inverse Problems of Mathematical Physics** A. A. Samarskii,Petr N. Vabishchevich,2008-08-27 The main classes of inverse problems for equations of mathematical physics and their numerical solution methods are considered in this book which is intended for graduate students and experts in applied mathematics computational mathematics and mathematical modelling **Mathematical and Computational Modeling** Roderick Melnik,2015-05-18 Mathematical and Computational Modeling Illustrates the application of mathematical and computational modeling in a variety of disciplines With an emphasis on the interdisciplinary nature of mathematical and computational modeling Mathematical and Computational Modeling With Applications in the Natural and Social Sciences Engineering and the Arts features chapters written by well known international experts in these fields and presents readers with a host of state of theart achievements in the development of mathematical modeling and computational experiment methodology The book is a valuable guide to the methods ideas and tools of applied and computational mathematics as they apply to other disciplines such as the natural and social sciences engineering and technology The book also features Rigorous mathematical procedures and applications as the driving force behind mathematical innovation and discovery Numerous examples from a wide range of disciplines to emphasize the multidisciplinary application and universality of applied mathematics and mathematical modeling Original results on both fundamental theoretical and applied developments in diverse areas of human knowledge Discussions that promote interdisciplinary interactions between mathematicians scientists and engineers Mathematical and Computational Modeling With Applications in the Natural and Social Sciences Engineering and the Arts is an ideal resource for professionals in various areas of mathematical and statistical sciences modeling and

simulation physics computer science engineering biology and chemistry and industrial and computational engineering The book also serves as an excellent textbook for graduate courses in mathematical modeling applied mathematics numerical methods operations research and optimization   **Heat Conduction** Vyacheslav Vikhrenko,2011-11-30 The content of this book covers several up to date approaches in the heat conduction theory such as inverse heat conduction problems non linear and non classic heat conduction equations coupled thermal and electromagnetic or mechanical effects and numerical methods for solving heat conduction equations as well The book is comprised of 14 chapters divided into four sections In the first section inverse heat conduction problems are discuss The first two chapters of the second section are devoted to construction of analytical solutions of nonlinear heat conduction problems In the last two chapters of this section wavelike solutions are attained The third section is devoted to combined effects of heat conduction and electromagnetic interactions in plasmas or in pyroelectric material elastic deformations and hydrodynamics Two chapters in the last section are dedicated to numerical methods for solving heat conduction problems   Mathematical Methods in Interdisciplinary Sciences Snehashish Chakraverty,2020-07-15 Brings mathematics to bear on your real world scientific problems Mathematical Methods in Interdisciplinary Sciences provides a practical and usable framework for bringing a mathematical approach to modelling real life scientific and technological problems The collection of chapters Dr Snehashish Chakraverty has provided describe in detail how to bring mathematics statistics and computational methods to the fore to solve even the most stubborn problems involving the intersection of multiple fields of study Graduate students postgraduate students researchers and professors will all benefit significantly from the author s clear approach to applied mathematics The book covers a wide range of interdisciplinary topics in which mathematics can be brought to bear on challenging problems requiring creative solutions Subjects include Structural static and vibration problems Heat conduction and diffusion problems Fluid dynamics problems The book also covers topics as diverse as soft computing and machine intelligence It concludes with examinations of various fields of application like infectious diseases autonomous car and monotone inclusion problems   Finite Difference Methods. Theory and Applications Ivan Dimov,István Faragó,Lubin Vulkov,2019-01-28 This book constitutes the refereed conference proceedings of the 7th International Conference on Finite Difference Methods FDM 2018 held in Lozenetz Bulgaria in June 2018 The 69 revised full papers presented together with 11 invited papers were carefully reviewed and selected from 94 submissions They deal with many modern and new numerical techniques like splitting techniques Green s function method multigrid methods and immersed interface method   **Fault Diagnosis Inverse Problems: Solution with Metaheuristics** Lídice Camps Echevarría,Orestes Llanes Santiago,Haroldo Fraga de Campos Velho,Antônio José da Silva Neto,2018-05-28 This book presents a methodology based on inverse problems for use in solutions for fault diagnosis in control systems combining tools from mathematics physics computational and mathematical modeling optimization and computational intelligence This methodology known as fault diagnosis inverse problem methodology or FD IPM unifies the results of several

years of work of the authors in the fields of fault detection and isolation FDI inverse problems and optimization The book clearly and systematically presents the main ideas concepts and results obtained in recent years By formulating fault diagnosis as an inverse problem and by solving it using metaheuristics the authors offer researchers and students a fresh interdisciplinary perspective for problem solving in these fields Graduate courses in engineering applied mathematics and computing also benefit from this work   Oil and Gas Reservoir Prospecting and Exploration Vladimir L. Trofimov,Fanil F. Khaziev,Alisa V. Trofimova,2022-05-31 This book discusses topical issues of detailed seismic data interpretation using high resolution seismic HRS techniques which are based on the numerical method developed by the authors for solving the inverse dynamic seismic problem IDSP The authors highlight the range of issues related to the development and application of HRS Geo technologies on a variety of seismic data and analyze a significant amount of practical material in various seismic and geological conditions This analysis allows for the accurate estimation of geological indicators in sediments that are most important for the prediction and exploration of oil and gas deposits including lithological composition reservoir properties and the nature and degree of reservoir rock saturation with fluids The book is intended for professionals involved in seismic data processing and geological interpretation students of geophysical and geological specialties graduate students of these specializations   *Numerical Methods for the Solution of Ill-Posed Problems* A.N. Tikhonov,A. Goncharsky,V.V. Stepanov,Anatoly G. Yagola,2013-03-09 Many problems in science technology and engineering are posed in the form of operator equations of the first kind with the operator and RHS approximately known But such problems often turn out to be ill posed having no solution or a non unique solution and or an unstable solution Non existence and non uniqueness can usually be overcome by settling for generalised solutions leading to the need to develop regularising algorithms The theory of ill posed problems has advanced greatly since A N Tikhonov laid its foundations the Russian original of this book 1990 rapidly becoming a classical monograph on the topic The present edition has been completely updated to consider linear ill posed problems with or without a priori constraints non negativity monotonicity convexity etc Besides the theoretical material the book also contains a FORTRAN program library Audience Postgraduate students of physics mathematics chemistry economics engineering Engineers and scientists interested in data processing and the theory of ill posed problems

Inverse Problems, Regularization Methods and Related Topics Sergei V. Pereverzyev,R. Radha,S. Sivananthan,2025-03-31 This book features a thoughtfully curated collection of research contributions spanning regularization theory integral equations learning theory and matrix and operator theory These contributions were presented in honor of Prof M Thamban Nair on his 65th birthday during the International Conference on Analysis Inverse Problems and Applications which took place at the IIT Madras in Chennai India from July 18 21 2022 The book is a valuable resource for graduate students engineers scientists and researchers looking to advance their work in the development of innovative regularization algorithms It comprises 14 chapters contributed by esteemed experts and emerging researchers

<u>Theoretical Chemical Engineering</u> Christo Boyadjiev,2010-10-20 The role of theory in science was formulated very brilliantly by Max Planck Experimenters are the striking force of science The experiment is a question which science puts to nature The measurement is the registration of nature s answer But before the question is put to nature it must be formulated Before the measurement result is used itmust be explained i e the answer must be understood correctly These two problems are obligations of the theoreticians Chemical engineering is an experimental science but theory permits us to formulate correct experimental conditions and to understand correctly the exp imental results The theoretical methods of chemical engineering for modeling and simulation of industrial processes are surveyed in this book Theoretical chemical engineering solves the problems that spring up from the necessity for a quantitative description of the processes in the chemical industry They are quite different at the different stages of the quantitative description i e a wide circle of theoretical methods are required for their solutions Modeling and simulation are a united approach to obtain a quantitative description of the processes and systems in chemical engineering and chemical technology which is necessary to clarify the process mechanism or for optimal process design process control and plant renovation Modeling is the creation of the mathematical model i e construction of the mathematical description on the basis of the process mechanism calculation of the model parameters using experimental data and statistical analysis of the model adequacy **Iterative Regularization Methods for Nonlinear Ill-Posed Problems** Barbara Kaltenbacher,Andreas Neubauer,Otmar Scherzer,2008-09-25 Nonlinear inverse problems appear in many applications and typically they lead to mathematical models that are ill posed i e they are unstable under data perturbations Those problems require a regularization i e a special numerical treatment This book presents regularization schemes which are based on iteration methods e g nonlinear Landweber iteration level set methods multilevel methods and Newton type methods **Regularization of Ill-Posed Problems by Iteration Methods** S.F. Gilyazov,N.L. Gol'dman,2013-04-17 Iteration regularization i e utilization of iteration methods of any form for the stable approximate solution of ill posed problems is one of the most important but still insufficiently developed topics of the new theory of ill posed problems In this monograph a general approach to the justification of iteration regulari zation algorithms is developed which allows us to consider linear and nonlinear methods from unified positions Regularization algorithms are the classical iterative methods steepest descent methods conjugate direction methods gradient projection methods etc complemented by the stopping rule depending on level of errors in input data They are investigated for solving linear and nonlinear operator equations in Hilbert spaces Great attention is given to the choice of iteration index as the regularization parameter and to estimates of errors of approximate solutions Stabilizing properties such as smoothness and shape constraints imposed on the solution are used On the basis of these investigations we propose and establish efficient regularization algorithms for stable numerical solution of a wide class of ill posed problems In particular descriptive regularization algorithms utilizing a priori information about the qualitative behavior of the sought solution and ensuring a substantial saving in computational costs are

considered for model and applied problems in nonlinear thermophysics The results of calculations for important applications in various technical fields a continuous casting the treatment of materials and perfection of heat protective systems using laser and composite technologies are given   **Regularization Methods in Banach Spaces** Thomas Schuster,Barbara Kaltenbacher,Bernd Hofmann,Kamil S. Kazimierski,2012-07-30 Regularization methods aimed at finding stable approximate solutions are a necessary tool to tackle inverse and ill posed problems Inverse problems arise in a large variety of applications ranging from medical imaging and non destructive testing via finance to systems biology Many of these problems belong to the class of parameter identification problems in partial differential equations PDEs and thus are computationally demanding and mathematically challenging Hence there is a substantial need for stable and efficient solvers for this kind of problems as well as for a rigorous convergence analysis of these methods This monograph consists of five parts Part I motivates the importance of developing and analyzing regularization methods in Banach spaces by presenting four applications which intrinsically demand for a Banach space setting and giving a brief glimpse of sparsity constraints Part II summarizes all mathematical tools that are necessary to carry out an analysis in Banach spaces Part III represents the current state of the art concerning Tikhonov regularization in Banach spaces Part IV about iterative regularization methods is concerned with linear operator equations and the iterative solution of nonlinear operator equations by gradient type methods and the iteratively regularized Gau Newton method Part V finally outlines the method of approximate inverse which is based on the efficient evaluation of the measured data with reconstruction kernels   **Regularization Algorithms for Ill-Posed Problems** Anatoly B. Bakushinsky,Mikhail M. Kokurin,Mikhail Yu. Kokurin,2018-02-05 This specialized and authoritative book contains an overview of modern approaches to constructing approximations to solutions of ill posed operator equations both linear and nonlinear These approximation schemes form a basis for implementable numerical algorithms for the stable solution of operator equations arising in contemporary mathematical modeling and in particular when solving inverse problems of mathematical physics The book presents in detail stable solution methods for ill posed problems using the methodology of iterative regularization of classical iterative schemes and the techniques of finite dimensional and finite difference approximations of the problems under study Special attention is paid to ill posed Cauchy problems for linear operator differential equations and to ill posed variational inequalities and optimization problems The readers are expected to have basic knowledge in functional analysis and differential equations The book will be of interest to applied mathematicians and specialists in mathematical modeling and inverse problems and also to advanced students in these fields Contents Introduction Regularization Methods For Linear Equations Finite Difference Methods Iterative Regularization Methods Finite Dimensional Iterative Processes Variational Inequalities and Optimization Problems   **Computational Methods for Inverse Problems in Imaging** Marco Donatelli,Stefano Serra-Capizzano,2019-11-26 This book presents recent mathematical methods in the area of inverse problems in imaging with a particular focus on the

computational aspects and applications The formulation of inverse problems in imaging requires accurate mathematical modeling in order to preserve the significant features of the image The book describes computational methods to efficiently address these problems based on new optimization algorithms for smooth and nonsmooth convex minimization on the use of structured numerical linear algebra and on multilevel techniques It also discusses various current and challenging applications in fields such as astronomy microscopy and biomedical imaging The book is intended for researchers and advanced graduate students interested in inverse problems and imaging *Numerical Methods and Applications* Geno Nikolov,Natalia Kolkovska,Krassimir Georgiev,2019-01-21 This book constitutes the thoroughly refereed post conference proceedings of the 9th International Conference on Numerical Methods and Applications NMA 2018 held in Borovets Bulgaria in August 2018 The 56 revised regular papers presented were carefully reviewed and selected from 61 submissions for inclusion in this book The papers are organized in the following topicalsections numerical search and optimization problem driven numerical method motivation and application numerical methods for fractional diffusion problems orthogonal polynomials and numerical quadratures and Monte Carlo and Quasi Monte Carlo methods *Approximate Solutions of Common Fixed-Point Problems* Alexander J. Zaslavski,2016-06-30 This book presents results on the convergence behavior of algorithms which are known as vital tools for solving convex feasibility problems and common fixed point problems The main goal for us in dealing with a known computational error is to find what approximate solution can be obtained and how many iterates one needs to find it According to know results these algorithms should converge to a solution In this exposition these algorithms are studied taking into account computational errors which remain consistent in practice In this case the convergence to a solution does not take place We show that our algorithms generate a good approximate solution if computational errors are bounded from above by a small positive constant Beginning with an introduction this monograph moves on to study dynamic string averaging methods for common fixed point problems in a Hilbert space dynamic string methods for common fixed point problems in a metric space p dynamic string averaging version of the proximal algorithm common fixed point problems in metric spaces common fixed point problems in the spaces with distances of the Bregman type a proximal algorithm for finding a common zero of a family of maximal monotone operators subgradient projections algorithms for convex feasibility problems in Hilbert spaces **Approximate Global Convergence and Adaptivity for Coefficient Inverse Problems** Larisa Beilina,Michael Victor Klibanov,2012-03-09 Approximate Global Convergence and Adaptivity for Coefficient Inverse Problems is the first book in which two new concepts of numerical solutions of multidimensional Coefficient Inverse Problems CIPs for a hyperbolic Partial Differential Equation PDE are presented Approximate Global Convergence and the Adaptive Finite Element Method adaptivity for brevity Two central questions for CIPs are addressed How to obtain a good approximations for the exact solution without any knowledge of a small neighborhood of this solution and how to refine it given the approximation The book also combines analytical convergence

results with recipes for various numerical implementations of developed algorithms The developed technique is applied to two types of blind experimental data which are collected both in a laboratory and in the field The result for the blind backscattering experimental data collected in the field addresses a real world problem of imaging of shallow explosives

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In some sort of inundated with monitors and the cacophony of quick transmission, the profound power and mental resonance of verbal beauty frequently diminish in to obscurity, eclipsed by the continuous onslaught of noise and distractions. Yet, situated within the musical pages of **Iterative Methods For Approximate Solution Of Inverse Problems**, a interesting perform of fictional elegance that pulses with raw feelings, lies an unforgettable journey waiting to be embarked upon. Composed by a virtuoso wordsmith, that exciting opus instructions viewers on an emotional odyssey, delicately exposing the latent potential and profound influence embedded within the delicate internet of language. Within the heart-wrenching expanse with this evocative examination, we will embark upon an introspective exploration of the book is central styles, dissect their charming writing model, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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