

Mathematics and Its Applications

A.B. Bakushinsky and
M. Yu. Kokurin

Iterative Methods for
Approximate Solution of
Inverse Problems



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Iterative Methods For Approximate Solution Of Inverse Problems Mathematics And Its Applications

A.B. Bakushinsky, M.Yu. Kokurin



Iterative Methods For Approximate Solution Of Inverse Problems Mathematics And Its Applications:

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 *Iterative Methods and Their Dynamics with Applications* Ioannis Konstantinos

Argyros, Angel Alberto Magreñán, 2017-07-12 Iterative processes are the tools used to generate sequences approximating solutions of equations describing real life problems Intended for researchers in computational sciences and as a reference book for advanced computational method in nonlinear analysis this book is a collection of the recent results on the convergence analysis of numerical algorithms in both finite dimensional and infinite dimensional spaces and presents several applications and connections with fixed point theory It contains an abundant and updated bibliography and provides comparisons between various investigations made in recent years in the field of computational nonlinear analysis The book also provides recent advancements in the study of iterative procedures and can be used as a source to obtain the proper method to use in order to solve a problem The book assumes a basic background in Mathematical Statistics Linear Algebra and Numerical Analysis and may be used as a self study reference or as a supplementary text for an advanced course in Biosciences or Applied Sciences Moreover the newest techniques used to study the dynamics of iterative methods are described and used in the book and they are compared with the classical ones *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 **Optimization and Regularization for Computational Inverse Problems and**

Applications Yanfei Wang, Anatoly G. Yagola, Changchun Yang, 2011-06-29 Optimization and Regularization for

Computational Inverse Problems and Applications focuses on advances in inversion theory and recent developments with practical applications particularly emphasizing the combination of optimization and regularization for solving inverse problems. This book covers both the methods including standard regularization theory, Fejer processes for linear and nonlinear problems, the balancing principle, extrapolated regularization, nonstandard regularization, nonlinear gradient method, the nonmonotone gradient method, subspace method, and Lie group method, and the practical applications such as the reconstruction problem for inverse scattering molecular spectra data processing, quantitative remote sensing inversion, seismic inversion using the Lie group method, and the gravitational lensing problem. Scientists, researchers, and engineers as well as graduate students engaged in applied mathematics, engineering, geophysics, medical science, image processing, remote sensing, and atmospheric science will benefit from this book. Dr Yanfei Wang is a Professor at the Institute of Geology and Geophysics, Chinese Academy of Sciences, China. Dr Sc Anatoly G Yagola is a Professor and Assistant Dean of the Physical Faculty, Lomonosov Moscow State University, Russia. Dr Changchun Yang is a Professor and Vice Director of the Institute of Geology and Geophysics, Chinese Academy of Sciences, China.

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

Advances in Inverse Problems for Partial Differential Equations Dinh-Liem Nguyen, Loc Hoang Nguyen, Thi-Phong Nguyen, 2023-04-12

This volume contains the proceedings of two AMS Special Sessions: Recent Developments on Analysis and Computation for Inverse Problems for PDEs, virtually held on March 13-14, 2021, and Recent Advances in Inverse Problems for Partial Differential Equations, virtually held on October 23-24, 2021. The papers in this volume focus on new results on numerical methods for various inverse problems arising in electrical impedance tomography, inverse scattering in radar and optics, problems of reconstruction of initial conditions, control of acoustic fields, and stock price forecasting. The authors studied iterative and non-iterative approaches such as optimization-based, globally convergent sampling, and machine learning-based methods. The volume provides an interesting source on advances in computational inverse problems for partial differential equations.

Computational Methods In Nonlinear Analysis: Efficient Algorithms, Fixed Point Theory And Applications Ioannis K Argyros, Said Hilout, 2013-07-11

The field of computational sciences has seen a considerable development in mathematics, engineering sciences, and economic equilibrium theory. Researchers in this field are faced with the problem of solving a variety of equations or variational inequalities. We note that in computational sciences, the practice of numerical analysis for finding such solutions is essentially connected to variants of Newton's method. The efficient computational methods for finding the solutions of fixed point problems, nonlinear equations, and variational inclusions are the first goal of the present book. The second goal is the applications of these methods in nonlinear problems and the connection with fixed point theory. This book is intended for researchers in computational sciences and as a reference book for an advanced computational methods in nonlinear analysis. We collect the recent results on the convergence analysis of numerical algorithms in both finite dimensional and infinite dimensional spaces.

and present several applications and connections with fixed point theory The book contains abundant and updated bibliography and provides comparison between various investigations made in recent years in the field of computational nonlinear analysis

Inverse Problems for Fractional Partial Differential Equations Barbara Kaltenbacher, William Rundell, 2023-07-17 As the title of the book indicates this is primarily a book on partial differential equations PDEs with two definite slants toward inverse problems and to the inclusion of fractional derivatives The standard paradigm or direct problem is to take a PDE including all coefficients and initial boundary conditions and to determine the solution The inverse problem reverses this approach asking what information about coefficients of the model can be obtained from partial information on the solution Answering this question requires knowledge of the underlying physical model including the exact dependence on material parameters The last feature of the approach taken by the authors is the inclusion of fractional derivatives This is driven by direct physical applications a fractional derivative model often allows greater adherence to physical observations than the traditional integer order case The book also has an extensive historical section and the material that can be called fractional calculus and ordinary differential equations with fractional derivatives This part is accessible to advanced undergraduates with basic knowledge on real and complex analysis At the other end of the spectrum lie nonlinear fractional PDEs that require a standard graduate level course on PDEs

Time-dependent Problems in Imaging and Parameter Identification Barbara Kaltenbacher, Thomas Schuster, Anne Wald, 2021-02-23 Inverse problems such as imaging or parameter identification deal with the recovery of unknown quantities from indirect observations connected via a model describing the underlying context While traditionally inverse problems are formulated and investigated in a static setting we observe a significant increase of interest in time dependence in a growing number of important applications over the last few years Here time dependence affects a the unknown function to be recovered and or b the observed data and or c the underlying process Challenging applications in the field of imaging and parameter identification are techniques such as photoacoustic tomography elastography dynamic computerized or emission tomography dynamic magnetic resonance imaging super resolution in image sequences and videos health monitoring of elastic structures optical flow problems or magnetic particle imaging to name only a few Such problems demand for innovation concerning their mathematical description and analysis as well as computational approaches for their solution

Modern Aspects of the Theory of Partial Differential Equations Michael Ruzhansky, Jens Wirth, 2011-05-04 The book provides a quick overview of a wide range of active research areas in partial differential equations The book can serve as a useful source of information to mathematicians scientists and engineers The volume contains contributions from authors from a large variety of countries on different aspects of partial differential equations such as evolution equations and estimates for their solutions control theory inverse problems nonlinear equations elliptic theory on singular domains numerical approaches

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

Quantitative Magnetic Resonance Imaging Nicole Seiberlich,Vikas Gulani,Adrienne Campbell-Washburn,Steven Sourbron,Mariya Ivanova Doneva,Fernando Calamante,Houchun Harry Hu,2020-11-18 Quantitative Magnetic Resonance Imaging is a go to reference for methods and applications of quantitative magnetic resonance imaging with specific sections on Relaxometry Perfusion and Diffusion Each section will start with an explanation of the basic techniques for mapping the tissue property in question including a description of the challenges that arise when using these basic approaches For properties which can be measured in multiple ways each of these basic methods will be described in separate chapters Following the basics a chapter in each section presents more advanced and recently proposed techniques for quantitative tissue property mapping with a concluding chapter on clinical applications The reader will learn The basic physics behind tissue property mapping How to implement basic pulse sequences for the quantitative measurement of tissue properties The strengths and limitations to the basic and more rapid methods for mapping the magnetic relaxation properties T1 T2 and T2 The pros and cons for different approaches to mapping perfusion The methods of Diffusion weighted imaging and how this approach can be used to generate diffusion tensor maps and more complex representations of diffusion How flow magneto electric tissue property fat fraction exchange elastography and temperature mapping are performed How fast imaging approaches including parallel imaging compressed sensing and Magnetic Resonance Fingerprinting can be used to accelerate or improve tissue property mapping schemes How tissue property mapping is used clinically in different organs Structured to cater for MRI researchers and graduate students with a wide variety of backgrounds Explains basic methods for quantitatively measuring tissue properties with MRI including T1 T2 perfusion diffusion fat and iron fraction elastography flow susceptibility enabling the implementation of pulse sequences to

perform measurements Shows the limitations of the techniques and explains the challenges to the clinical adoption of these traditional methods presenting the latest research in rapid quantitative imaging which has the possibility to tackle these challenges Each section contains a chapter explaining the basics of novel ideas for quantitative mapping such as compressed sensing and Magnetic Resonance Fingerprinting based approaches

Computational Methods for Inverse Problems and Applications Amine Laghrib, Mourad Nachaoui, Lekbir Afraites, 2025-07-24 This book highlights recent trends in inverse problems and their integration with computer science a field rapidly evolving yet underexplored mathematically ICMDs 2024 aims to unite scientists to explore the latest in mathematics and its applications across various scientific disciplines Key topics include inverse problems partial differential equations mathematical control numerical analysis and computer science Our goal is to provide substantial mathematical insights and practical applications to bridge this gap With its growing significance in media and industry this event promises to attract a diverse audience and foster collaboration across scientific domains The main contribution of this book is to give some sufficient mathematical content with expressive results and accurate applications As a growing field it is gaining a lot of attention both in media as well as in the industry world which will attract the interest of readers from different scientist discipline

An Introduction to the Mathematical Theory of Inverse Problems Andreas Kirsch, 2021-02-15 This graduate level textbook introduces the reader to the area of inverse problems vital to many fields including geophysical exploration system identification nondestructive testing and ultrasonic tomography It aims to expose the basic notions and difficulties encountered with ill posed problems analyzing basic properties of regularization methods for ill posed problems via several simple analytical and numerical examples The book also presents three special nonlinear inverse problems in detail the inverse spectral problem the inverse problem of electrical impedance tomography EIT and the inverse scattering problem The corresponding direct problems are studied with respect to existence uniqueness and continuous dependence on parameters Ultimately the text discusses theoretical results as well as numerical procedures for the inverse problems including many exercises and illustrations to complement coursework in mathematics and engineering This updated text includes a new chapter on the theory of nonlinear inverse problems in response to the field s growing popularity as well as a new section on the interior transmission eigenvalue problem which complements the Sturm Liouville problem and which has received great attention since the previous edition was published

Operator Theory and Its Applications Alexander G. Ramm, P. N. Shivakumar, Abraham Vilgelmovich Strauss, 2000 Together with the papers on the abstract operator theory are many papers on the theory of differential operators boundary value problems inverse scattering and other inverse problems and on applications to biology chemistry wave propagation and many other areas BOOK JACKET

Solutions of Fixed Point Problems with Computational Errors Alexander J. Zaslavski, 2024-03-19 The book is devoted to the study of approximate solutions of fixed point problems in the presence of computational errors It begins with a study of approximate solutions of star shaped feasibility problems in the presence of

perturbations The goal is to show the convergence of algorithms which are known as important tools for solving convex feasibility problems and common fixed point problems The text also presents studies of algorithms based on unions of nonexpansive maps inconsistent convex feasibility problems and split common fixed point problems A number of algorithms are considered for solving convex feasibility problems and common fixed point problems The book will be of interest for researchers and engineers working in optimization numerical analysis and fixed point theory It also can be useful in preparation courses for graduate students The main feature of the book which appeals specifically to this audience is the study of the influence of computational errors for several important algorithms used for nonconvex feasibility problems

Applied Mechanics Reviews ,1973

Ill-Posed Problems with A Priori Information V. V. Vasin,A. L.

Ageev,2013-02-18 The Inverse and Ill Posed Problems Series is a series of monographs publishing postgraduate level information on inverse and ill posed problems for an international readership of professional scientists and researchers The series aims to publish works which involve both theory and applications in e g physics medicine geophysics acoustics electrodynamics tomography and ecology

Surveys on Solution Methods for Inverse Problems David Colton,Heinz W.

Engl,Alfred K. Louis,Joyce McLaughlin,William Rundell,2012-12-06 Inverse problems are concerned with determining causes for observed or desired effects Problems of this type appear in many application fields both in science and in engineering The mathematical modelling of inverse problems usually leads to ill posed problems i e problems where solutions need not exist need not be unique or may depend discontinuously on the data For this reason numerical methods for solving inverse problems are especially difficult special methods have to be developed which are known under the term regularization methods This volume contains twelve survey papers about solution methods for inverse and ill posed problems and about their application to specific types of inverse problems e g in scattering theory in tomography and medical applications in geophysics and in image processing The papers have been written by leading experts in the field and provide an up to date account of solution methods for inverse problems

Encyclopaedia of Mathematics M. Hazewinkel,2013-12-01

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