

Iterative Regularization Methods for Nonlinear Ill-Posed Problems

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Regularization Of Ill Posed Problems By Iteration Methods

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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 regularization 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

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. **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 Methods for Approximate Solution of Inverse Problems* A.B.

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 for Ill-Posed Problems*

Anatoly B. Bakushinsky, Mihail Yu. Kokurin, Alexandra Smirnova, 2010-12-23 Ill posed problems are encountered in countless areas of real world science and technology. A variety of processes in science and engineering is commonly modeled by algebraic, differential, integral and other equations. In a more difficult case it can be systems of equations combined with the

associated initial and boundary conditions Frequently the study of applied optimization problems is also reduced to solving the corresponding equations These equations encountered both in theoretical and applied areas may naturally be classified as operator equations The current textbook will focus on iterative methods for operator equations in Hilbert spaces

Handbook of Mathematical Methods in Imaging Otmar Scherzer, 2010-11-23 The Handbook of Mathematical Methods in Imaging provides a comprehensive treatment of the mathematical techniques used in imaging science The material is grouped into two central themes namely Inverse Problems Algorithmic Reconstruction and Signal and Image Processing Each section within the themes covers applications modeling mathematics numerical methods using a case example and open questions Written by experts in the area the presentation is mathematically rigorous The entries are cross referenced for easy navigation through connected topics Available in both print and electronic forms the handbook is enhanced by more than 150 illustrations and an extended bibliography It will benefit students scientists and researchers in applied mathematics Engineers and computer scientists working in imaging will also find this handbook useful

Computational Methods in Nonlinear Analysis Ioannis K. Argyros, Saïd Hilout, 2013 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

Multidisciplinary Methods for Analysis, Optimization and Control of Complex Systems Vincenzo Capasso, Jacques Periaux, 2006-01-05 This book consists of lecture notes of a summer school named after the late Jacques Louis Lions The summer school was designed to alert both Academia and Industry to the increasing role of multidisciplinary methods and tools for the design of complex products in various areas of socio economic interest This volume offers the reader a rare opportunity of being exposed to the presentation of real industrial and societal problems together with the relevant innovative methods used

Integral Methods in Science and Engineering M. Zuhair Nashed, D. Rollins, 2006-11-24 The quantitative and qualitative study of the physical world makes use of many mathematical models governed by a great diversity of ordinary partial differential integral and integro differential equations An essential step in such investigations is the solution of these types of equations

which sometimes can be performed analytically while at other times only numerically This edited self contained volume presents a series of state of the art analytic and numerical methods of solution constructed for important problems arising in science and engineering all based on the powerful operation of exact or approximate integration The volume may be used as a reference guide and a practical resource It is suitable for researchers and practitioners in applied mathematics physics and mechanical and electrical engineering as well as graduate students in these disciplines *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 **Applied and Computational Control, Signals, and Circuits** Biswa N. Datta, 1999-07-28 The purpose of this annual series Applied and Computational Control Signals and Circuits is to keep abreast of the fast paced developments in computational mathematics and scientific computing and their increasing use by researchers and engineers in control signals and circuits The series is dedicated to fostering effective communication between mathematicians computer scientists computational scientists software engineers theorists and practicing engineers This interdisciplinary scope is meant to blend areas of mathematics such as linear algebra operator theory and certain branches of analysis and computational mathematics numerical linear algebra numerical differential equations large scale and parallel matrix computations numerical optimization with control and systems theory signal and image processing and circuit analysis and design The disciplines mentioned above have long enjoyed a natural synergy There are distinguished journals in the fields of control and systems theory as well as signal processing and circuit theory which publish high quality papers on mathematical and engineering aspects of these areas however articles on their computational and applications aspects appear only sporadically At the same time there has been tremendous recent growth and development of computational mathematics scientific computing and mathematical software and the resulting sophisticated techniques are being gradually adapted by engineers software designers and other scientists to the needs of those applied disciplines **Inverse Magnetometry** Christian Blick, Willi Freeden, M. Zuhair Nashed, Helga Nutz, Michael Schreiner, 2021-09-08 This monograph presents the geoscientific context arising in decorrelative geomagnetic exploration First an insight into the current state of research is given by reducing magnetometry to mathematically

accessible and thus calculable decorrelated models In this way various questions and problems of magnetometry are made available to a broad scientific audience and the exploration industry New stimuli are given and innovative ways of modeling geologic strata by mollifier magnetometric techniques are shown Potential data sets primarily of terrestrial origin constitute the main data basis in the book For deep geology the geomathematical decorrelation methods are designed in such a way that depth information e g in boreholes may be canonically entered Overall this book provides pioneering and ground breaking innovative mathematical knowledge as a transfer methodology from the reality space of magnetometric measurements into the virtual space of mathematical numerical modeling structures and mollifier solutions with novel geological application areas It pursues a double goal On the one hand it represents a geoscientific set of rules for today s geoengineering interested in the application of innovative modelling and simulation techniques to promising data sets and structures occurring in geomagnetics On the other hand the book serves as a collection of current material in Applied Mathematics to offer alternative methodologies in the theory of inverse problems

Analysis of the Robin-Dirichlet iterative procedure for solving the Cauchy problem for elliptic equations with extension to unbounded domains Pauline Achieng, 2020-10-26 In this thesis we study the Cauchy problem for elliptic equations It arises in many areas of application in science and engineering as a problem of reconstruction of solutions to elliptic equations in a domain from boundary measurements taken on a part of the boundary of this domain The Cauchy problem for elliptic equations is known to be ill posed We use an iterative regularization method based on alternatively solving a sequence of well posed mixed boundary value problems for the same elliptic equation This method based on iterations between Dirichlet Neumann and Neumann Dirichlet mixed boundary value problems was first proposed by Kozlov and Maz ya 13 for Laplace equation and Lamé system but not Helmholtz type equations As a result different modifications of this original regularization method have been proposed in literature We consider the Robin Dirichlet iterative method proposed by Mpinganzima et al 3 for the Cauchy problem for the Helmholtz equation in bounded domains We demonstrate that the Robin Dirichlet iterative procedure is convergent for second order elliptic equations with variable coefficients provided the parameter in the Robin condition is appropriately chosen We further investigate the convergence of the Robin Dirichlet iterative procedure for the Cauchy problem for the Helmholtz equation in an unbounded domain We derive and analyse the necessary conditions needed for the convergence of the procedure In the numerical experiments the precise behaviour of the procedure for different values of k^2 in the Helmholtz equation is investigated and the results show that the speed of convergence depends on the choice of the Robin parameters 0 and 1 In the unbounded domain case the numerical experiments demonstrate that the procedure is convergent provided that the domain is truncated appropriately and the Robin parameters 0 and 1 are also chosen appropriately

Computer Vision -- ACCV 2009 Hongbin Zha, Rin-ichiro Taniguchi, Stephen Maybank, 2010-05-09 It gives us great pleasure to present the proceedings of the 9th Asian Conference on Computer Vision ACCV 2009 held in Xi an

China in September 2009 This was the rst ACCV conference to take place in mainland China We received a total of 670 full submissions which is a new record in the ACCV series Overall 35 papers were selected for oral presentation and 131 as posters yielding acceptance rates of 5.2% for oral 19.6% for poster and 24.8% in total In the paper reviewing we continued the tradition of previous ACCVs by conducting the process in a double blind manner Each of the 33 Area Chairs received a pool of about 20 papers and nominated a number of potential reviewers for each paper Then Program Committee Chairs allocated at least three reviewers to each paper taking into consideration any conflicts of interest and the balance of loads Once the reviews were finished the Area Chairs made summary reports for the papers in their pools based on the reviewers comments and on their own assessments of the papers

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

Regularized Image Reconstruction in Parallel MRI with MATLAB Joseph Suresh Paul, Raji Susan Mathew, 2019-11-05 Regularization becomes an integral part of the reconstruction process in accelerated parallel magnetic resonance imaging pMRI due to the need for utilizing the most discriminative information in the form of parsimonious models to generate high quality images with reduced noise and artifacts Apart from providing a detailed overview and implementation details of various pMRI reconstruction methods Regularized image reconstruction in parallel MRI with MATLAB examples interprets regularized image reconstruction in pMRI as a means to effectively control the balance between two specific types of error signals to either improve the accuracy in estimation of missing samples or speed up the estimation process The first type corresponds to the modeling error between acquired and their estimated values The second type arises due to the perturbation of k space values in autocalibration methods or sparse approximation in the compressed sensing based reconstruction model Features Provides details for optimizing regularization parameters in each type of reconstruction Presents comparison of regularization approaches for each type of pMRI reconstruction Includes discussion of case studies using clinically acquired data MATLAB codes are provided for each reconstruction type Contains method wise description of adapting regularization to optimize speed and accuracy This book serves as a reference material for researchers and students involved in development of pMRI reconstruction methods Industry practitioners concerned with how to apply regularization in pMRI reconstruction will find this book most useful

Matrices, Moments and Quadrature with Applications Gene H. Golub, Gérard Meurant, 2009-12-07 This computationally oriented book describes and explains the mathematical relationships among matrices moments orthogonal polynomials quadrature rules and the Lanczos and conjugate gradient algorithms The book bridges different mathematical areas to obtain algorithms to estimate bilinear forms involving two vectors and a function of the matrix The first part of the book provides the necessary mathematical background and explains the theory The second part describes the

applications and gives numerical examples of the algorithms and techniques developed in the first part Applications addressed in the book include computing elements of functions of matrices obtaining estimates of the error norm in iterative methods for solving linear systems and computing parameters in least squares and total least squares and solving ill posed problems using Tikhonov regularization This book will interest researchers in numerical linear algebra and matrix computations as well as scientists and engineers working on problems involving computation of bilinear forms *Splitting Algorithms, Modern Operator Theory, and Applications* Heinz H. Bauschke, Regina S. Burachik, D. Russell Luke, 2019-11-06 This book brings together research articles and state of the art surveys in broad areas of optimization and numerical analysis with particular emphasis on algorithms The discussion also focuses on advances in monotone operator theory and other topics from variational analysis and nonsmooth optimization especially as they pertain to algorithms and concrete implementable methods The theory of monotone operators is a central framework for understanding and analyzing splitting algorithms Topics discussed in the volume were presented at the interdisciplinary workshop titled Splitting Algorithms Modern Operator Theory and Applications held in Oaxaca Mexico in September 2017 Dedicated to Jonathan M Borwein one of the most versatile mathematicians in contemporary history this compilation brings theory together with applications in novel and insightful ways *Computation and Applied Mathematics* ,2006

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