Methode De Quasi Reversibilite Et Applications

This book is intended for &tudents, research engineers, and mathematicians interested in applications or numerical analysis. Pure analysts will also find some new problems to tackle. Most of the material can be understood by a reader with a relatively modest knowledge of differential and inte gral equations and functional analysis. Readers interested in stochastic optimization will find a new theory of prac tical . importance. Readers interested in problems of static and quasi-static electrodynamics, wave scattering by small bodies of arbitrary shape, and corresponding applications in geophysics, optics, and radiophysics will find explicit analytical formulas for the scattering matrix, polarizability tensor, electrical capacitance of bodies of an arbitrary shape; numerical examples showing the practical utility of these formulas; two-sided variational estimates for the pol arizability tensor; and some open problems such as working out a standard program for calculating the capacitance and polarizability of bodies of arbitrary shape and numerical calculation of multiple integrals with weak singularities. Readers interested in nonlinear vibration theory will find a new method for qualitative study of stationary regimes in the general one-loop passive nonlinear network, including stabil ity in the large, convergence, and an iterative process for calculation the stationary regime. No assumptions concerning the smallness of the nonlinearity or the filter property of the linear one-port are made. New results in the theory of nonlinear operator equations form the basis for the study.
Physical formulations leading to ill-posed problems Basic concepts of the theory of ill-posed problems Analytic continuation Boundary value problems for differential equations Volterra equations Integral geometry Multidimensional inverse problems for linear differential equations
Méthode de quasi-réversibilité et applicationsMéthodes de quasi-réversibilité et de lignes de niveau appliquées aux problèmes inverses elliptiques
The first international conference "Ill-Posed Problems in Natural Sciences" was held in Moscow, August 1991. This Proceedings volume contains selected papers by well-known specialists in the theory and applications of ill-posed and inverse problems. The book covers a wide spectrum of topics such as theoretical mathematical physics, numerical methods in medicine, astrophysics, geophysics, electrodynamics, tomography, mass and heat transport theory, optics and other fields.
This book contains the results in numerical analysis and optimization presented at the ECCOMAS thematic conference “Computational Analysis and Optimization” (CAO 2011) held in Jyväskylä, Finland, June 9–11, 2011. Both the conference and this volume are dedicated to Professor Pekka Neittaanmäki on the occasion of his sixtieth birthday. It consists of five parts that are closely related to his scientific activities and interests: Numerical Methods for Nonlinear Problems; Reliable Methods for Computer Simulation; Analysis of Noised and Uncertain Data; Optimization Methods; Mathematical Models Generated by Modern Technological Problems. The book also includes a short biography of Professor Neittaanmäki.
This volume contains the proceedings of the 4th International Conference on Numerical Methods and Applications. The major topics covered include: general finite difference, finite volume, finite element and boundary element methods, general numerical linear algebra and parallel computations, numerical methods for nonlinear problems and multiscale methods, multigrid and domain decomposition methods, CFD computations, mathematical modeling in structural mechanics, and environmental and engineering applications. The volume reflects the current research trends in the specified areas of numerical methods and their applications. Contents: Computational Issues in Large Scale Eigenvalue ProblemsCombustion Modeling in Industrial FurnacesMonte Carlo MethodsMultilevel Methods for Incompressible Viscous FlowsApproximation of Nonlinear and Functional PDEsSolving Linear Systems with Error ControlRegular Numerical Methods for Inverse and Ill-Posed ProblemsMultifield ProblemsParallel and Distributed Numerical Computing with ApplicationsParameter-Robust Numerical Methods for Singularly Perturbed and Convection-Dominated ProblemsFinite Difference MethodsFinite Element MethodsFinite Volume MethodsBoundary Element MethodsNumerical Linear AlgebraNumerical Methods for Nonlinear ProblemsNumerical Methods for Multiscale ProblemsMultigrid and Domain DecompositionComputational Fluid DynamicsMathematical Modelling in Structural MechanicsEnvironmental ModellingEngineering Applications Readership: Researchers in applied mathematics and computational physics. Keywords:Numerical Methods and Applications;General Finite Difference;General Numerical Linear Algebra;Parallel Computations;Nonlinear Problems and Multiscale Methods
A knowledge of the mechanical behaviour of both naturally occurring materials, such as soils and rocks, and artificial materials such as concrete and industrial granular matter, is of fundamental importance to their proper use in engineering and scientific applications. This volume contains selected lectures by international experts on current developments and problems in the numerical modelling of cohesive-frictional materials which provide a deeper understanding of the microscopic and macroscopic description of such materials. This book fills a gap by emphasizing the cross-fertilization of ideas between engineers and scientists engaged in this exciting field of research.
Dynamical Systems Method for Solving Nonlinear Operator Equations is of interest to graduate students in functional analysis, numerical analysis, and ill-posed and inverse problems especially. The book presents a general method for solving operator equations, especially nonlinear and ill-posed. It requires a fairly modest background and is essentially self-contained. All the results are proved in the book, and some of the background material is also included. The results presented are mostly obtained by the author. Contains a systematic development of a novel general method, the dynamical systems method, DSM for solving operator equations, especially nonlinear and ill-posed Self-contained, suitable for wide audience Can be used for various courses for graduate students and partly for undergraduates (especially for RUE classes)
A two volume collection of mathematical papers on algebra and mathematics in honor of famed Russian mathematician, I.M. Vinogradov.

Interest in regularization methods for ill-posed nonlinear operator equations and variational inequalities of monotone type in Hilbert and Banach spaces has grown rapidly over recent years. Results in the field over the last three decades, previously only available in journal articles, are comprehensively explored with particular attention given to applications of regularization methods as well as to practical methods used in computational analysis.

In this monograph the theory and methods of solving inverse Stefan problems for quasilinear parabolic equations in regions with free boundaries are developed. The study of this new class of ill-posed problems is motivated by the needs of the mod eling and control of nonlinear processes with phase transitions in thermophysics and mechanics of continuous media. Inverse Stefan problems are important for the perfection of technologies both in high temperature processes (e.g., metallurgy, the aircraft industry, astronautics and power engineering) and in hydrology, exploitation of oil-gas fields, etc. The proposed book will complete a gap in these subjects in the preceding re searches of ill-posed problems. It contains the new theoretical and applied studies of a wide class of inverse Stefan problems. The statements of such problems on the determination of boundary functions and coefficients of the equation are considered for different types of additional information about their solution. The variational method of obtaining stable approximate solutions is proposed and established. It is implemented by an efficient computational scheme of descriptive regularization. This algorithm utilizes a priori knowledge of the qualitative structure of the sought solution and ensures a substantial saving in computational costs. It is tested on model and applied problems in nonlinear thermophysics. In particular, the results of calculations for important applications in continuous casting of ingots and in the melting of a plate with the help of laser technology are presented.

Combining mathematical theory, physical principles, and engineering problems, Generalized Calculus with Applications to Matter and Forces examines generalized functions, including the Heaviside unit jump and the Dirac unit impulse and its derivatives of all orders, in one and several dimensions. The text introduces the two main approaches to generalized functions: (1) as a nonuniform limit of a family of ordinary functions, and (2) as a functional over a set of test functions from which properties are inherited. The second approach is developed more extensively to encompass multidimensional generalized functions whose arguments are ordinary functions of several variables. As part of a series of books for engineers and scientists exploring advanced mathematics, Generalized Calculus with Applications to Matter and Forces presents generalized functions from an applied point of view, tackling problem classes such as: Gauss and Stokes’ theorems in the differential geometry, tensor calculus, and theory of potential fields Self-adjoint and non-self-adjoint problems for linear differential equations and nonlinear problems with large deformations Multipolar expansions and Green’s functions for elastic strings and bars, potential and rotational flow, electro- and magnetostatics, and more This third volume in the series Mathematics and Physics for Science and Technology is designed to complete the theory of functions and its application to potential fields, relating generalized functions to broader follow-on topics like differential equations. Featuring step-by-step examples with interpretations of results and discussions of assumptions and their consequences, Generalized Calculus with Applications to Matter and Forces enables readers to construct mathematical–physical models suited to new observations or novel engineering devices.

This is a version of Gevrey's classical treatise on the heat equations. Included in this volume are discussions of initial and/or boundary value problems, numerical methods, free boundary problems and parameter determination problems. The material is presented as a monograph and/or information source book. After the first six chapters of standard classical material, each chapter is written as a self-contained unit except for an occasional reference to elementary definitions, theorems and lemmas in previous chapters.

The text demonstrates the methods for proving the existence (if at all) and finding of inverse and ill-posed problems solutions in linear algebra, integral and operator equations, integral geometry, spectral inverse problems, and inverse scattering problems. It is given comprehensive background material for linear ill-posed problems and for coefficient inverse problems for hyperbolic, parabolic, and elliptic equations. A lot of examples for inverse problems from physics, geophysics, biology, medicine, and other areas of application of mathematics are included.

Complex analytical methods are a powerful tool for special partial differential equations and systems. To make these methods applicable for a wider class, transformations and transmutations are used.

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.

Moment Theory is not a new subject; however, in classical treatments, the ill-posedness of the problem is not taken into account - hence this monograph. Assuming a "true" solution to be uniquely determined by a sequence of moments (given as integrals) of which only finitely many are inaccurately given, the authors describe and analyze several regularization methods and derive stability estimates. Mathematically, the task often consists in the reconstruction of an analytic or harmonic function, as is natural from concrete applications discussed (e.g. inverse heat conduction problems, Cauchy's problem for the Laplace equation, gravimetry). The book can be used in a graduate or upper undergraduate course in Inverse Problems, or as supplementary reading for a course on Applied Partial Differential Equations.

This monograph presents theoretical methods involving the Hamilton–Jacobi–Bellman formalism in conjunction with set-valued techniques of nonlinear analysis to solve significant problems in dynamics and control. The emphasis is on issues of reachability, feedback control synthesis under complex state constraints, hard or double bounds on controls, and performance in finite time. Guaranteed state estimation, output feedback control, and hybrid dynamics are also discussed. Although the focus is on systems with linear structure, the authors indicate how to apply each approach to nonlinear and nonconvex systems. The main theoretical results lead to computational schemes based on extensions of ellipsoidal calculus that provide complete solutions to the problems. These computational schemes in turn yield software tools that can be applied effectively to high-dimensional systems. Ellipsoidal Techniques for Problems of Dynamics and Control: Theory and Computation will interest graduate and senior undergraduate students, as well as researchers and practitioners interested in control theory, its applications, and its computational realizations.

Ce travail s'intéresse à l'utilisation de la méthode de quasi-réversibilité pour la résolution de problèmes inverses, un exemple typique étant le problème inverse de l'obstacle. Nous proposons pour ce dernier une nouvelle approche couplant la méthode de quasi-réversibilité et une méthode de lignes de niveau. Plus précisément, à partir d'un ouvert candidat C, nous résolvons un problème de Cauchy à l'extérieur de C, puis nous mettons à jour cet ouvert par la méthode de lignes de niveau. La solution approchée du

problème de Cauchy est obtenue en utilisant la méthode de quasi-réversibilité, introduite par J.L. Lions et R. Lattes dans les années soixante. Nous proposons différentes formulations de cette méthode, ainsi que sa discrétisation par éléments finis non conformes adaptés à l'espace de Sobolev H2, et nous prouvons la convergence des éléments finis. En présence d'une donnée bruitée, nous introduisons une nouvelle méthode basée sur la dualité en optimisation et le principe de Morozov. Nous montrons que cette méthode fournit des données régularisées et un choix de paramètre de régularisation pertinent pour la quasi-réversibilité. En ce qui concerne la mise à jour de l'ouvert C, nous proposons deux méthodes de lignes de niveau très différentes : la première est basée sur une équation eikonale, la seconde sur une équation de Poisson. Nous prouvons que ces deux approches assurent la convergence vers l'obstacle. Finalement, nous présentons des résultats numériques pour cette approche couplant quasi-réversibilité/lignes de niveau dans différentes situations : problème inverse de l'obstacle avec condition de Dirichlet, détection de défauts dans une structure élasto-plastique

The Encyclopaedia of Mathematics is the most up-to-date, authoritative and comprehensive English-language work of reference in mathematics which exists today. With over 7,000 articles from `A-integral' to `Zygmund Class of Functions', supplemented with a wealth of complementary information, and an index volume providing thorough cross-referencing of entries of related interest, the Encyclopaedia of Mathematics offers an immediate source of reference to mathematical definitions, concepts, explanations, surveys, examples, terminology and methods. The depth and breadth of content and the straightforward, careful presentation of the information, with the emphasis on accessibility, makes the Encyclopaedia of Mathematics an immensely useful tool for all mathematicians and other scientists who use, or are confronted by, mathematics in their work. The Enclyclopaedia of Mathematics provides, without doubt, a reference source of mathematical knowledge which is unsurpassed in value and usefulness. It can be highly recommended for use in libraries of universities, research institutes, colleges and even schools.

The nature and the human creations are full of complex phenomena, which sometimes can be observed but rarely follow our hypotheses. The best we can do is to build a parametric model and then try to adjust the unknown parameters based on the available observations. This topic, called parameter identification, is discussed in this book for materials and structures. The present volume of lecture notes follows a very successful advanced school, which we had the honor to coordinate in Udine, October 6-10, 2003. The authors of this volume present a wide spectrum of theories, methods and applications related to inverse and parameter identification problems. We thank the invited lecturers and the authors of this book for their contributions, the participants of the course for their active participation and the interesting discussions as well as the people of CISMfor their hospitality and their well-known professional help. Zenon Mroz Georgios E. Stavroulakis CONTENTS Preface An overview of enhanced modal identification by L. Bolognini 1 The reciprocity gap functional for identifying defects and cracks by H. D. Bui, A. Constantinescu and H. Maigre 17 Some innovative industrial prospects centered on inverse analyses by G. Maier, M. Bocciarelli andR. Fedele 55 Identification of damage in beam and plate structures using parameter dependent modal changes and thermographic methods by Z. Mroz andK. Dems 95 Crack and flaw identification in statics and dynamics, using filter algorithms and soft computing by G. E, Stavroulakis, M. Engelhardt andH.

This research monograph presents a systematic treatment of the theory of the propagation of transient electromagnetic fields (such as optical pulses) through dielectric media which exhibit both dispersion a.nd absorption. The work divides naturally into two parts. Part I presents a summary of the fundamental theory of the radiation and propagation of rather general electromagnetic waves in causal, linear media which are homogeneous and isotropic but which otherwise have rather general dispersive and absorbing properties. In Part II, we specialize to the propagation of a plane, transient electromagnetic field in a homogeneous dielectric. Although we have made some contributions to the fundamental theory given in Part I, most of the results of our own research appear in Part II. The purpose of the theory presented in Part II is to predict and to explain in explicit detail the dynamics of the field after it has propagated far enough through the medium to be in the mature-dispersion regime. It is the subject of a classic theory, based on the research conducted by A. Sommerfeld and L.

Computational Models is a component of Encyclopedia of Mathematical Sciences in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. Modern Computational Mathematics arises in a wide variety of fields, including business, economics, engineering, finance, medicine and science. The Theme on Computational Models provides the essential aspects of Computational Mathematics emphasizing Basic Methods for Solving Equations; Numerical Analysis and Methods for Ordinary Differential Equations; Numerical Methods and Algorithms; Computational Methods and Algorithms; Numerical Models and Simulation. These two volumes are aimed at those seeking in-depth of advanced knowledge: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs

This book deals mainly with the results of the authors' research devoted to both the study of the transport equation (the linear Boltzmann equation) and its applications in X-ray tomography. The introduction gives an outline of the book and deals with certain aspects of the methodology. The first part of the book is devoted to the investigation of known and new problems for the stationary transport equation of a general form. New problems are treated as problems of tomography. The second part deals with the monoenergetic transport equation. This book will be of interest to specialists in transport theory and tomography.

Demonstrates the application of DSM to solve a broad range of operator equations The dynamical systems method (DSM) is a powerful computational method for solving operator equations. With this book as their guide, readers will master the application of DSM to solve a variety of linear and nonlinear problems as well as ill-posed and well-posed problems. The authors offer a clear, step-by-step, systematic development of DSM that enables readers to grasp the method's underlying logic and its numerous applications. Dynamical Systems Method and Applications begins with a general introduction and then sets

forth the scope of DSM in Part One. Part Two introduces the discrepancy principle, and Part Three offers examples of numerical applications of DSM to solve a broad range of problems in science and engineering. Additional featured topics include: General nonlinear operator equations Operators satisfying a spectral assumption Newton-type methods without inversion of the derivative Numerical problems arising in applications Stable numerical differentiation Stable solution to ill-conditioned linear algebraic systems Throughout the chapters, the authors employ the use of figures and tables to help readers grasp and apply new concepts. Numerical examples offer original theoretical results based on the solution of practical problems involving ill-conditioned linear algebraic systems, and stable differentiation of noisy data. Written by internationally recognized authorities on the topic, Dynamical Systems Method and Applications is an excellent book for courses on numerical analysis, dynamical systems, operator theory, and applied mathematics at the graduate level. The book also serves as a valuable resource for professionals in the fields of mathematics, physics, and engineering.

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.

As a rule, many practical problems are studied in a situation when the input data are incomplete. For example, this is the case for a parabolic partial differential equation describing the non-stationary physical process of heat and mass transfer if it contains the unknown thermal conductivity coefficient. Such situations arising in physical problems motivated the appearance of the present work. In this monographthe author considers numerical solutions of the quasi-inversion problems, to which the solution of the original coefficient inverse problems are reduced. Underground fluid dynamics is taken as a field of practical use of coefficient inverse problems. The significance of these problems for this application domain consists in the possibility to determine the physical fields of parameters that characterize the filtration properties of porous media (oil strata). This provides the possibility of predicting the conditions of oil-field development and the effects of the exploitation. The research carried out by the author showed that the quasi-inversion method can be applied also for solution of "interior coefficient inverse problems" by reducing them to the problem of continuation of a solution to a parabolic equation. This reduction is based on the results of the proofs of the uniqueness theorems for solutions of the corresponding coefficient inverse problems.

This book is intended to help advanced undergraduate, graduate, and postdoctoral students in their daily work by offering them a compendium of numerical methods. The choice of methods pays significant attention to error estimates, stability and convergence issues, as well as optimization of program execution speeds. Numerous examples are given throughout the chapters, followed by comprehensive end-of-chapter problems with a more pronounced physics background, while less stress is given to the explanation of individual algorithms. The readers are encouraged to develop a certain amount of skepticism and scrutiny instead of blindly following readily available commercial tools. The second edition has been enriched by a chapter on inverse problems dealing with the solution of integral equations, inverse Sturm-Liouville problems, as well as retrospective and recovery problems for partial differential equations. The revised text now includes an introduction to sparse matrix methods, the solution of matrix equations, and pseudospectra of matrices; it discusses the sparse Fourier, non-uniform Fourier and discrete wavelet transformations, the basics of non-linear regression and the Kolmogorov-Smirnov test; it demonstrates the key concepts in solving stiff differential equations and the asymptotics of Sturm-Liouville eigenvalues and eigenfunctions. Among other updates, it also presents the techniques of state-space reconstruction, methods to calculate the matrix exponential, generate random permutations and compute stable derivatives.

Soils are complex materials: they have a particulate structure and fluids can seep through pores, mechanically interacting with the solid skeleton. Moreover, at a microscopic level, the behaviour of the solid skeleton is highly unstable. External loadings are in fact taken by grain chains which are continuously destroyed and rebuilt. Many issues of modeling, even of the physical details of the phenomena, remain open, even obscure; de Gennes listed them not long ago in a critical review. However, despite physical complexities, soil mechanics has developed on the assumption that a soil can be seen as a continuum, or better yet as a medium obtained by the superposition of two and sometimes three con and the other fluids, which occupy the same portion of tinua, one solid space. Furthermore, relatively simple and robust constitutive laws were adopted to describe the stress-strain behaviour and the interaction between the solid and the fluid continua. The contrast between the intrinsic nature of soil and the simplistic engi neering approach is self-evident. When trying to describe more and more sophisticated phenomena (static liquefaction, strain localisation, cyclic mo bility, effects of diagenesis and weathering, ...), the nalve description of soil must be abandoned or, at least, improved. Higher order continua, incrementally non-linear laws, micromechanical considerations must be taken into account. A new world was opened, where basic mathematical questions (such as the choice of the best tools to model phenomena and the proof of the well-posedness of the consequent problems) could be addressed.

This book contains a novel theory of random fields estimation of Wiener type, developed originally by the author and presented here. No assumption about the Gaussian or Markovian nature of the fields are made. The theory, constructed entirely within the framework of covariance theory, is based on a detailed analytical study of a new class of multidimensional integral equations basic in estimation theory.This book is suitable for graduate courses in random fields estimation. It can also be used in courses in functional analysis, numerical analysis, integral equations, and scattering theory.