Geophysical Inverse Theory And Regularization Problems

The Method of Approximate Inverse: Theory and ApplicationsInverse Theory and Applications in GeophysicsInverse Theory and Applications for EngineersGeophysical Inverse Theory and Regularization ProblemsInverse Problem Theory and Methods for Model Parameter EstimationGeophysical Data Analysis: Discrete Inverse TheoryTheory and Applications of Inverse ProblemsInverse ProblemsGeophysical Data Analysis: Understanding Inverse Problem Theory and PracticeInverse and Ill-posed ProblemsInverse theory and applications for engineersGeophysical Data Analysis: Discrete Inverse TheoryGeneralized InverseGeophysical Inversion Theory and Global Optimization MethodsDynamical Inverse Problems: Theory and ApplicationInverse Problems in EngineeringElements of the Theory of Inverse ProblemsInverse Problems in EngineeringInside OutInverse Problem Theory Thomas Schuster Michael S. Zhdanov Edward Hensel Michael S. Zhdanov Albert Tarantola William Menke H. Haario Mathias Richter Max A. Meju Sergey I. Kabanikhin William Menke Caiyun Liu Graham M. L. Gladwell Didier Delaunay A. M. Denisov Keith A. Woodbury Gunther Uhlmann A. Tarantola

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this book is concerned with the method of approximate inverse which is a regularization technique for stably solving inverse problems in various settings it demonstrates the performance and functionality of the method on several examples from medical imaging and non destructive testing such as computerized tomography doppler tomography sonar x ray diffractometry and thermoacoustic computerized tomography

geophysical inverse theory and applications second edition brings together fundamental results developed by the russian mathematical school in regularization theory and combines them with the related research in geophysical inversion carried out in the west it presents a detailed exposition of the methods of regularized solution of inverse problems based on the ideas of tikhonov regularization and shows the different forms of their applications in both linear and nonlinear methods of geophysical inversion it s the first book of its kind to treat many kinds of inversion and imaging techniques in a unified mathematical manner the book is divided in five parts covering the foundations of the inversion theory and its applications to the solution of different geophysical inverse problems including potential field electromagnetic and seismic methods unique in its focus on providing a link between the methods used in gravity electromagnetic and seismic imaging and inversion it represents an exhaustive treatise on inversion theory written by one of the world s foremost experts this work is widely recognized as the ultimate researcher s reference on geophysical inverse theory and its practical scientific applications presents state of the art geophysical inverse theory developed in modern mathematical terminology the first to treat many kinds of inversion and imaging techniques in a unified mathematical way provides a critical link between the methods used in gravity electromagnetic and seismic imaging and inversion and represents an exhaustive treatise on geophysical inversion theory features more than 300 illustrations figures charts and graphs to underscore key concepts reflects the latest developments in inversion theory and applications and captures the most significant changes in the field over the past decade

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fundamental results developed by the russian mathematical school in regularization theory and combines them with the related research in geophysical inversion carried out in the west it presents a detailed exposition of the methods of regularized solution of inverse problems based on the ideas of tikhonov regularization and shows the different forms of their applications in both linear and nonlinear methods of geophysical inversion this text is the first to treat many kinds of inversion and imaging techniques in a unified mathematical manner the book is divided in five parts covering the foundations of the inversion theory and its applications to the solution of different geophysical inverse problems including potential field electromagnetic and seismic methods the first part is an introduction to inversion theory the second part contains a description of the basic methods of solution of the linear and nonlinear inverse problems using regularization the following parts treat the application of regularization methods in gravity and magnetic electromagnetic and seismic inverse problems the key connecting idea of these applied parts of the book is the analogy between the solutions of the forward and inverse problems in different geophysical methods the book also includes chapters related to the modern technology of geophysical imaging based on seismic and electromagnetic migration this volume is unique in its focus on providing a link between the methods used in gravity electromagnetic and seismic imaging and inversion and represents an exhaustive treatise on inversion theory

this book proposes a general approach to the basic difficulties appearing in the resolution of inverse problems

geophysical data analysis discrete inverse theory is an introductory text focusing on discrete inverse theory that is concerned with parameters that either are truly discrete or can be adequately approximated as discrete organized into 12 chapters the book s opening chapters provide a general background of inverse problems and their corresponding solution as well as some of the basic concepts from probability theory that are applied throughout the text chapters 3 7 discuss the solution of the canonical inverse problem that is the linear problem with gaussian statistics and discussions on problems that are non gaussian and nonlinear are covered in chapters 8 and 9 chapters 10 12 present examples of the use of inverse theory and a discussion on the numerical algorithms that must be employed to solve inverse problems on a computer this book is of value to graduate students and many college seniors in the applied sciences

this textbook is an introduction to the subject of inverse problems with an emphasis on practical solution methods and applications from geophysics the treatment is mathematically rigorous relying on calculus and linear algebra only familiarity with more advanced mathematical theories like functional analysis is not required containing up to date methods this book will provide readers with the tools necessary to compute regularized solutions of inverse problems a variety of practical examples from geophysics are used to motivate the presentation of abstract mathematical ideas thus assuring an accessible approach beginning with four examples of inverse problems the opening chapter establishes core concepts such as formalizing these problems as equations in vector spaces and addressing the key issue of ill posedness chapter two then moves on to the discretization of inverse problems which is a prerequisite for solving them on computers readers will be well prepared for the final chapters that present regularized solutions of inverse problems in finite dimensional spaces with chapter three covering linear problems and chapter four studying nonlinear problems model problems reflecting scenarios of practical interest in the geosciences such as inverse gravimetry and full waveform inversion are fully worked out throughout the book they are used as test cases to illustrate all single steps of solving inverse problems up to numerical computations five appendices include the mathematical foundations needed to fully understand the material this second edition expands upon the first particularly regarding its up to date treatment of nonlinear problems following the author s approach readers will understand the relevant theory and methodology needed to pursue more complex applications inverse problems is ideal for graduate students and researchers interested in geophysics and geosciences

geophysical data analysis is a very practical subject and this book is intended to be a simple guide to the techniques of parameter estimation and error analysis i have placed emphasis on the reconciliation of theory and practical data to enable the reader understand how to tackle typical problems in data analysis it is hoped that a mastery of the simple techniques described in this book will inspire confidence in the reader to consult the more classical treatment of the subject it is pertinent to mention that this book developed out of a highly successful course of the same title given to senior undergraduate geophysics students in leicester university since 1988 and its popularity stems from the structured learning programs and the simple effective practical approach to geophysical inversion the course is

given in the first semester to provide students with the basic tools for quantitative analysis of geoscientific data and consists of 10 lectures and practical sessions involving the materials given in chapters 1 to 9 in this book chapter 10 derives from topical issues of research interest to me and my induction courses for postgraduate students in geophysics and the industry the contents of this book are easily digestible and require little statistical or mathematical commitment

the theory of ill posed problems originated in an unusual way as a rule a new concept is a subject in which its creator takes a keen interest the concept of ill posed problems was introduced by hadamard with the comment that these problems are physically meaningless and not worthy of the attention of serious researchers despite hadamard s pessimistic forecasts however his unloved child has turned into a powerful theory whose results are used in many fields of pure and applied mathematics what is the secret of its success the answer is clear ill posed problems occur everywhere and it is unreasonable to ignore them unlike ill posed problems inverse problems have no strict mathematical definition in general they can be described as the task of recovering a part of the data of a corresponding direct well posed problem from information about its solution inverse problems were first encountered in practice and are mostly ill posed the urgent need for their solution especially in geological exploration and medical diagnostics has given powerful impetus to the development of the theory of ill posed problems nowadays the terms inverse problem and ill posed problem are inextricably linked to each other inverse and ill posed problems are currently attracting great interest a vast literature is devoted to these problems making it necessary to systematize the accumulated material this book is the first small step in that direction we propose a classification of inverse problems according to the type of equation unknowns and additional information we consider specific problems from a single position and indicate relationships between them the problems relate to different areas of mathematics such as linear algebra theory of integral equations integral geometry spectral theory and mathematical physics we give examples of applied problems that can be studied using the techniques we describe this book was conceived as a textbook on the foundations of the theory of inverse and ill posed problems for university students the author s intention was to explain this complex material in the most accessible way possible the monograph is aimed primarily at those who are just beginning to get to grips with inverse and ill posed problems but we hope that it will

be useful to anyone who is interested in the subject

since 1984 geophysical data analysis has filled the need for a short concise reference on inverse theory for individuals who have an intermediate background in science and mathematics the new edition maintains the accessible and succinct manner for which it is known with the addition of matlab examples and problem sets advanced color graphics coverage of new topics including adjoint methods inversion by steepest descent monte carlo and simulated annealing methods and bootstrap algorithm for determining empirical confidence intervals additional material on probability including bayesian influence probability density function and metropolis algorithm detailed discussion of application of inverse theory to tectonic gravitational and geomagnetic studies numerous examples and end of chapter homework problems help you explore and further understand the ideas presented use as classroom text facilitated by a complete set of exemplary lectures in microsoft powerpoint format and homework problem solutions for instructors

geophysical inversion is an ill posed problem classical local search method for inversion is depend on initial guess and easy to be trapped in local optimum the global optimization is a group of novel methods to deal with the problems mentioned above the book introduces the geophysical inversion theory including the classical solving approaches firstly then it introduces several typical global inversion approaches including particle swarm optimization pso differential evolution de and multiobjective optimization methods as well as some examples to inverse the geophysical data such as gravity mt sounding well logging self potential seismic data using these global optimization approaches

the papers in this volume present an overview of the general aspects and practical applications of dynamic inverse methods through the interaction of several topics ranging from classical and advanced inverse problems in vibration isospectral systems dynamic methods for structural identification active vibration control and damage detection imaging shear stiffness in biological tissues wave propagation to computational and experimental aspects relevant for engineering problems

presents 79 papers from the june 1996 conference covering a wide range of topics in the areas of mathematics mechanics and heat transfer presented by scientists mathematicians and engineers from the u s and europe papers include treatments of bidimensional inversion in microwave radiometric imaging iteration schemes for inverse obstacle problems and inverse approach to plasto hydrodynamic lubrication annotation copyrighted by book news inc portland or

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

in this book leading experts in the theoretical and applied aspects of inverse problems offer extended surveys on several important topics

inverse problem theory is written for physicists geophysicists and all scientists facing the problem of quantitative interpretation of experimental data although it contains a lot of mathematics it is not intended as a mathematical book but rather tries to explain how a method of acquisition of information can be applied to the actual world the book provides a comprehensive up to date description of the methods to be used for fitting experimental data or to estimate model parameters and to unify these methods into the inverse problem theory the first part of the book deals with discrete problems and describes maximum likelihood monte carlo least squares and least absolute values methods the second part deals with inverse problems involving functions the book is almost completely self contained with all important concepts carefully introduced although theoretical concepts are strongly emphasized the author has ensured that all the useful formulas are listed with many special cases included the book will thus serve equally well as a reference manual for researchers needing to refresh their memories on a given algorithm or as a textbook in a course for undergraduate or graduate students

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