Inverse problems arise when we reconstruct a sharper image from a blurred one or reconstruct the underground mass density.
from measurements of the gravity above the ground. When we solve an inverse problem, we compute the source that gives rise to some observed data using a mathematical model for the relation between the source and the data. This book gives an introduction to the practical treatment of inverse problems by means of numerical methods, with a focus on basic mathematical and computational aspects. To solve inverse problems, we demonstrate that insight about them goes hand in hand with algorithms. Discrete Inverse Problems: Insight and Algorithms includes a number of tutorial exercises that give the reader hands-on experience with the methods, difficulties, and challenges associated with the treatment of inverse problems. It also includes examples and figures that illustrate the theory and algorithms. Audience: This book is written for graduate students, researchers, and professionals in engineering and other areas that depend on solving inverse problems with noisy data. The aim is to provide readers with enough background that they can solve simple inverse problems and read more advanced literature on the subject. Contents: Preface; List of Symbols; Chapter 1: Introduction and Motivation; Chapter 2: Meet the Fredholm Integral Equation of the First Kind; Chapter 3: Getting to Business: Discretizations of Linear Inverse Problems; Chapter 4: Computational Aspects: Regularization Methods; Chapter 5: Getting Serious: Choosing the Regularization Parameter; Chapter 6: Toward Real-World Problems: Iterative Regularization; Chapter 7: Regularization Methods at Work: Solving Real Problems; Chapter 8: Beyond the 2-Norm: The Use of Discrete Smoothing Norms; Appendix A: Linear Algebra Stuff; Appendix B: Symmetric Toeplitz-Plus-Hankel Matrices and the DCT; Appendix C: Early Work on Tikhonov Regularization; Bibliography; Index

Discrete Inverse Problems Algorithms Fundamentals Related Books

Discrete Inverse and State Estimation Problems: With Geophysical Fluid Applications (Volume 2)
The problems of making inferences about the natural world from noisy observations and imperfect theories occur in almost all scientific disciplines. This 2006 book addresses these problems using examples taken from geophysical fluid dynamics. It focuses on discrete formulations, both static and time-varying, known variously as inverse, state estimation or data assimilation problems. Starting with fundamental algebraic and statistical ideas, the book guides the reader through a range of inference...

Using mathematical tools from number theory and finite fields, Applied Algebra: Codes, Ciphers, and Discrete Algorithms, Second Edition presents practical methods for solving problems in data security and data integrity. It is designed for an applied algebra course for students who have had prior classes in abstract or linear algebra. While the content has been reworked and improved, this edition continues to cover many algorithms that arise in cryptography and error-control codes. New to the S...

Inverse Synthetic Aperture Radar Imaging With MATLAB Algorithms
This book provides a full representation of Inverse Synthetic Aperture Radar (ISAR) imagery, which is a popular and important radar signal processing tool. The book covers all possible aspects of ISAR imaging. The book offers a fair amount of signal processing techniques and radar basics before introducing the inverse problem of ISAR and the forward problem of Synthetic Aperture Radar (SAR). Important concepts of SAR such as resolution, pulse compression and image formation are given together wi...

Inverse Problems in Engineering Mechanics II
Inverse Problems are found in many areas of engineering mechanics and there are many successful applications e.g. in non-destructive testing and characterization of material properties by ultrasonic or X-ray techniques, thermography, etc. Generally speaking, inverse problems are concerned with the determination of the input and the characteristics of a system, given certain aspects of its output. Mathematically, such problems are ill-posed and have to be overcome through development of new compu...

Solving Direct and Inverse Heat Conduction Problems
This book presents a solution for direct and inverse heat conduction problems, discussing the theoretical basis for the heat transfer process and presenting selected theoretical and numerical problems in the form of exercises with solutions. The book covers one-, two- and three dimensional problems which are solved by using exact and approximate analytical methods and numerical methods. An accompanying CD-Rom includes computational solutions of the examples and extensive FORTRAN code.
Large-Scale Inverse Problems and Quantification of Uncertainty

This book focuses on computational methods for large-scale statistical inverse problems and provides an introduction to statistical Bayesian and frequentist methodologies. Recent research advances for approximation methods are discussed, along with Kalman filtering methods and optimization-based approaches to solving inverse problems. The aim is to cross-fertilize the perspectives of researchers in the areas of data assimilation, statistics, large-scale optimization, applied and computational ma...

Statistical and Computational Inverse Problems (Applied Mathematical Sciences) (v. 160)

This book covers the statistical mechanics approach to computational solution of inverse problems, an innovative area of current research with very promising numerical results. The techniques are applied to a number of real world applications such as limited angle tomography, image deblurring, electrical impedance tomography, and biomagnetic inverse problems. Contains detailed examples throughout and includes a chapter on case studies where such methods have been implemented in biomedical eng...


Software developers and computer scientists have eagerly awaited this comprehensive revision of Robert Sedgewick's landmark texts on algorithms. Sedgewick has completely revamped all five sections, illuminating today's best algorithms for an exceptionally wide range of tasks. This shrink-wrapped package brings together Algorithms in C, Third Edition, Parts 1-4 and his new Algorithms in C, Third Edition, Part 5. Together, these books are definitive: the most up-to-date and practical algorithms re...

Fair: Flexible Algorithms for Image Registration (Fundamentals of Algorithms)

Whenever images taken at different times, from different viewpoints, and/or by different sensors need to be compared, merged, or integrated, image registration is required. Registration, also known as alignment, fusion, or warping, is the process of transforming data into a common reference frame. This book provides an overview of state-of-the-art registration techniques from theory to practice, plus numerous exercises designed to enhance readers understanding of the principles and mechanisms o...

Proceedings of the Seventeenth Annual ACM-SIAM Symposium on Discrete Algorithms

Symposium held in Miami, Florida, January 22-24, 2006. This symposium is jointly sponsored by the ACM Special Interest Group on Algorithms and Computation Theory and the SIAM Activity Group on Discrete Mathematics. Contents Preface; Acknowledgments; Session 1A: Confronting Hardness Using a Hybrid Approach, Virginia Vassilevska, Ryan Williams, and Shan Leung Maverick Woo; A New Approach to Proving Upper Bounds for MAX-2-SAT, Arist Kojevnikov and Alexander S. Kulikov, Measure and Conquer: A Simple O...
Inverse Function Theorem