

1. Record Nr.	UNINA9911019449703321
Autore	Seo Jin Keun
Titolo	Nonlinear inverse problems in imaging // Jin Keun Seo, Eung Je Woo
Pubbl/distr/stampa	Chichester, West Sussex, U.K., : John Wiley & Sons Inc., 2013
ISBN	9781118478141 1118478142 9781283993845 1283993848 9781118478172 1118478177 9781118478158 1118478150
Edizione	[1st edition]
Descrizione fisica	1 online resource (375 p.)
Altri autori (Persone)	WooE. J (Eung Je)
Disciplina	621.36/70151
Soggetti	Image processing - Mathematics Cross-sectional imaging - Mathematics Inverse problems (Differential equations) Nonlinear theories
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Machine generated contents note: Preface List of Abbreviations 1 Introduction 1.1 Forward Problem 1.2 Inverse Problem 1.3 Issues in Inverse Problem Solving 1.4 Linear, Nonlinear and Linearized Problems 2 Signal and System as Vectors 2.1 Vector Space 2.1.1 Vector Space and Subspace 2.1.2 Basis, Norm and Inner Product 2.1.3 Hilbert Space 2.2 Vector Calculus 2.2.1 Gradient 2.2.2 Divergence 2.2.3 Curl 2.2.4 Curve 2.2.5 Curvature 2.3 Taylor's Expansion 2.4 Linear System of Equations 2.4.1 Linear System and Transform 2.4.2 Vector Space of Matrix 2.4.3 Least Square Solution 2.4.4 Singular Value Decomposition (SVD) 2.4.5 Pseudo-inverse 2.5 Fourier Transform 2.5.1 Series Expansion 2.5.2 Fourier Transform 2.5.3 Discrete Fourier Transform (DFT) 2.5.4 Fast Fourier Transform (FFT) 2.5.5 Two-dimensional Fourier Transform References 3 Basics for Forward Problem 3.1 Understanding

PDE using Images as Examples 3.2 Heat Equation 3.2.1 Formulation of Heat Equation 3.2.2 One-dimensional Heat Equation 3.2.3 Two-dimensional Heat Equation and Isotropic Diffusion 3.2.4 Boundary Conditions 3.3 Wave Equation 3.4 Laplace and Poisson Equations 3.4.1 Boundary Value Problem 3.4.2 Laplace Equation in a Circle 3.4.3 Laplace Equation in Three-dimensional Domain 3.4.4 Representation Formula for Poisson Equation References 4 Analysis for Inverse Problem 4.1 Examples of Inverse Problems in Medical Imaging 4.1.1 Electrical Property Imaging 4.1.2 Mechanical Property Imaging 4.1.3 Image Restoration 4.2 Basic Analysis 4.2.1 Sobolev Space 4.2.2 Some Important Estimates 4.2.3 Helmholtz Decomposition 4.3 Variational Problems 4.3.1 Lax-Milgram Theorem 4.3.2 Ritz Approach 4.3.3 Euler-Lagrange Equations 4.3.4 Regularity Theory and Asymptotic Analysis 4.4 Tikhonov Regularization and Spectral Analysis 4.4.1 Overview of Tikhonov Regularization 4.4.2 Bounded Linear Operators in Banach Space 4.4.3 Regularization in Hilbert Space or Banach Space 4.5 Basics of Real Analysis 4.5.1 Riemann Integrable 4.5.2 Measure Space 4.5.3 Lebesgue Measurable Function 4.5.4 Pointwise, Uniform, Norm Convergence and Convergence in Measure 4.5.5 Differentiation Theory References 5 Numerical Methods 5.1 Iterative Method for Nonlinear Problem 5.2 Numerical Computation of One-dimensional Heat equation 5.2.1 Explicit Scheme 5.2.2 Implicit Scheme 5.2.3 Crank-Nicolson Method 5.3 Numerical Solution of Linear System of Equations 5.3.1 Direct Method using LU Factorization 5.3.2 Iterative Method using Matrix Splitting 5.3.3 Iterative Method using Steepest Descent Minimization 5.3.4 Conjugate Gradient (CG) Method 5.4 Finite Difference Method (FDM) 5.4.1 Poisson Equation 5.4.2 Elliptic Equation 5.5 Finite Element Method (FEM) 5.5.1 One-dimensional Model 5.5.2 Two-dimensional Model 5.5.3 Numerical Examples References 6 CT, MRI and Image Processing Problems 6.1 X-ray CT 6.1.1 Inverse Problem 6.1.2 Basic Principle and Nonlinear Effects 6.1.3 Inverse Radon Transform 6.1.4 Artifacts in CT 6.2 MRI 6.2.1 Basic Principle 6.2.2 K-space Data 6.2.3 Image Reconstruction 6.3 Image Restoration 6.3.1 Role of p in (6.35) 6.3.2 Total Variation Restoration 6.3.3 Anisotropic Edge-preserving Diffusion 6.3.4 Sparse Sensing 6.4 Segmentation 6.4.1 Active Contour Method 6.4.2 Level Set Method 6.4.3 Motion Tracking for Echocardiography References 7 Electrical Impedance Tomography 7.1 Introduction 7.2 Measurement Method and Data 7.2.1 Conductivity and Resistance 7.2.2 Permittivity and Capacitance 7.2.3 Phasor and Impedance 7.2.4 Admittivity and Trans-impedance 7.2.5 Electrode Contact Impedance 7.2.6 EIT System 7.2.7 Data Collection Protocol and Data Set 7.2.8 Linearity between Current and Voltage 7.3 Representation of Physical Phenomena 7.3.1 Derivation of Elliptic PDE 7.3.2 Elliptic PDE for Four-electrode Method 7.3.3 Elliptic PDE for Two-electrode Method 7.3.4 Min-max Property of Complex Potential 7.4 Forward Problem and Model 7.4.1 Continuous Neumann-to-Dirichlet Data 7.4.2 Discrete Neumann-to-Dirichlet Data 7.4.3 Nonlinearity between Admittivity and Voltage 7.5 Uniqueness Theory and Direct Reconstruction Method 7.5.1 Calderon's Approach 7.5.2 Uniqueness and Three-dimensional Reconstruction: Infinite Measurements 7.5.3 Nachmann's \bar{D} Method in Two Dimension 7.6 Backprojection Algorithm 7.7 Sensitivity and Sensitivity Matrix 7.7.1 Perturbation and Sensitivity 7.7.2 Sensitivity Matrix 7.7.3 Linearization 7.7.4 Quality of Sensitivity Matrix 7.8 Inverse Problem of EIT 7.8.1 Inverse Problem of RC Circuit 7.8.2 Formulation of EIT Inverse Problem 7.8.3 Ill-posedness of EIT Inverse Problem 7.9 Static Imaging 7.9.1 Iterative Data Fitting Method 7.9.2 Static Imaging using 4-channel EIT System 7.9.3 Regularization 7.9.4 Technical Difficulty of Static Imaging 7.10 Time-

difference Imaging 7.10.1 Data Sets for Time-difference Imaging
 7.10.2 Equivalent Homogeneous Admittivity 7.10.3 Linear Time-
 difference Algorithm using Sensitivity Matrix 7.10.4 Interpretation of
 Time-difference Image 7.11 Frequency-difference Imaging 7.11.1 Data
 Sets for Frequency-difference Imaging 7.11.2 Simple Difference $F_t, \omega; 2\text{-minus}; F_t, \omega; 1$ 7.11.3 Weighted Difference $F_t, \omega; 2\text{-minus}; [\alpha] F_t, \omega; 1$ 7.11.4 Linear Frequency-difference
 Algorithm using Sensitivity Matrix 7.11.5 Interpretation of Frequency-
 difference Image References 8 Anomaly Estimation and Layer Potential
 Techniques 8.1 Harmonic Analysis and Potential Theory 8.1.1 Layer
 Potentials and Boundary Value Problems for Laplace Equation 8.1.2
 Regularity for Solution of Elliptic Equation along Boundary of
 Inhomogeneity 8.2 Anomaly Estimation using EIT 8.2.1 Size Estimation
 Method 8.2.2 Location Search Method 8.3 Anomaly Estimation using
 Planar Probe 8.3.1 Mathematical Formulation 8.3.2 Representation
 Formula References 9 Magnetic Resonance Electrical Impedance
 Tomography 9.1 Data Collection using MRI 9.1.1 Measurement of B_z
 9.1.2 Noise in Measured B_z Data 9.1.3 Measurement of $B = (B_x, B_y, B_z)$
 9.2 Forward Problem and Model Construction 9.2.1 Relation between J, B_z
 and $\sigma; \nabla \cdot u$ 9.2.2 Three Key Observations 9.2.3 Data B_z Traces
 $\sigma; \nabla \cdot u$ 9.2.4 z-directional Change of $\sigma; \nabla \cdot u$ 9.3 Inverse Problem
 Formulation using B or J 9.4 Inverse Problem Formulation using B_z
 9.4.1 Model with Two Linearly Independent Currents 9.4.2 Uniqueness
 9.4.3 Defected B_z Data in a Local Region 9.5 Image Reconstruction
 Algorithm 9.5.1 J-substitution Algorithm 9.5.2 Harmonic B_z Algorithm
 9.5.3 Gradient B_z Decomposition and Variational B_z Algorithm 9.5.4
 Local Harmonic B_z Algorithm 9.5.5 Sensitivity Matrix Based Algorithm
 9.5.6 Anisotropic Conductivity Reconstruction Algorithm 9.5.7 Other
 Algorithms 9.6 Validation and Interpretation 9.6.1 Image
 Reconstruction Procedure using Harmonic B_z Algorithm 9.6.2
 Conductivity Phantom Imaging 9.6.3 Animal Imaging 9.6.4 Human
 Imaging 9.7 Applications References 10 Magnetic Resonance
 Elastography 10.1 Representation of Physical Phenomena 10.1.1
 Overview of Hooke's Law 10.1.2 Strain Tensor in Lagrangian
 Coordinates 10.2 Forward Problem and Model 10.3 Inverse Problem in
 MRE 10.4 Reconstruction Algorithms 10.4.1 Reconstruction of $[\mu]$
 with the Assumption of Local Homogeneity 10.4.2 Reconstruction of
 $[\mu]$ without the Assumption of Local Homogeneity 10.4.3 Anisotropic
 Elastic Moduli Reconstruction 10.5 Technical Issues in MRE References.

Sommario/riassunto

"This book provides researchers and engineers in the imaging field with the skills they need to effectively deal with nonlinear inverse problems associated with different imaging modalities, including impedance imaging, optical tomography, elastography, and electrical source imaging. Focusing on numerically implementable methods, the book bridges the gap between theory and applications, helping readers tackle problems in applied mathematics and engineering. Complete, self-contained coverage includes basic concepts, models, computational methods, numerical simulations, examples, and case studies. Provides a step-by-step progressive treatment of topics for ease of understanding. Discusses the underlying physical phenomena as well as implementation details of image reconstruction algorithms as prerequisites for finding solutions to non linear inverse problems with practical significance and value. Includes end of chapter problems, case studies and examples with solutions throughout the book. Companion website will provide further examples and solutions, experimental data sets, open problems, teaching material such as PowerPoint slides and software including MATLAB m files. Essential reading for Graduate

students and researchers in imaging science working across the areas of applied mathematics, biomedical engineering, and electrical engineering and specifically those involved in nonlinear imaging techniques, impedance imaging, optical tomography, elastography, and electrical source imaging"--
