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Seismic Amplitude Inversion in Reflection Tomography

by Y. WANG

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Seismic Amplitude Inversion In Reflection Tomography

Luc T. Ikelle

Seismic Amplitude Inversion In Reflection Tomography:

Seismic Amplitude Inversion in Reflection Tomography Yanghua Wang,2003 This is the first book of its kind on seismic amplitude inversion in the context of reflection tomography The aim of the monograph is to advocate the use of ray amplitude data separately or jointly with traveltime data in reflection seismic tomography The emphasis of seismic exploration is on imaging techniques so that seismic section can be interpreted directly as a geological section In contrast it is perhaps ironic that in decades of industrial seismology one major aspect of waveform data that potentially is easier to measure and analyse has generally been ignored That is the information content of seismic amplitudes Perhaps the potential complexity has deterred most researchers from a more thorough investigation of the practical use of seismic amplitude data The author of this volume presents an authoritative and detailed study of amplitude data as used in conjunction with traveltime data to provide better constraints on the variation of seismic wave speed in the subsurface One of the fundamental problems in conventional reflection seismic tomography using only traveltime data is the possible ambiguity between the velocity variation and the reflector depth The inclusion of amplitude data in the inversion may help to resolve this problem because the amplitudes and traveltimes are sensitive to different features of the subsurface model and thereby provide more accurate information about the subsurface structure and the velocity distribution An essential goal of this monograph is to make the amplitude inversion method work with real reflection seismic data Seismic Amplitude Inversion in Reflection Tomography Yanghua Wang,2003-02-25 This is the first book of its kind on seismic amplitude inversion in the context of reflection tomography The aim of the monograph is to advocate the use of ray amplitude data separately or jointly with traveltime data in reflection seismic tomography The emphasis of seismic exploration is on imaging techniques so that seismic section can be interpreted directly as a geological section In contrast it is perhaps ironic that in decades of industrial seismology one major aspect of waveform data that potentially is easier to measure and analyse has generally been ignored That is the information content of seismic amplitudes Perhaps the potential complexity has deterred most researchers from a more thorough investigation of the practical use of seismic amplitude data The author of this volume presents an authoritative and detailed study of amplitude data as used in conjunction with traveltime data to provide better constraints on the variation of seismic wave speed in the subsurface One of the fundamental problems in conventional reflection seismic tomography using only traveltime data is the possible ambiguity between the velocity variation and the reflector depth The inclusion of amplitude data in the inversion may help to resolve this problem because the amplitudes and traveltimes are sensitive to different features of the subsurface model and thereby provide more accurate information about the subsurface structure and the velocity distribution An essential goal of this monograph is to make the amplitude inversion method work with real reflection seismic data **Basic Theory in Reflection Seismology** J.K. Costain,C. Coruh,2004-10-27 The material in this volume provides the basic theory necessary to understand the principles behind imaging the subsurface of the Earth using reflection

and refraction seismology For reflection seismology the end product is a record section from a collection of wiggly traces that are recorded in the field from which information about the properties of subsurface structure and rock can be derived For the most part the principles of imaging are the same regardless of the depth to the target the same mathematical background is necessary for targeting a shallow water table as for investigating the base of the earth s continental crust at a depth of 30 50 km **Seismic Inversion** Yanghua Wang,2016-09-15 Seismic inversion aims to reconstruct a quantitative model of the Earth subsurface by solving an inverse problem based on seismic measurements There are at least three fundamental issues to be solved simultaneously non linearity non uniqueness and instability This book covers the basic theory and techniques used in seismic inversion corresponding to these three issues emphasising the physical interpretation of theoretical concepts and practical solutions This book is written for master and doctoral students who need to understand the mathematical tools and the engineering aspects of the inverse problem needed to obtain geophysically meaningful solutions Building on the basic theory of linear inverse problems the methodologies of seismic inversion are explained in detail including ray impedance inversion and waveform tomography etc The application methodologies are categorised into convolutional and wave equation based groups This systematic presentation simplifies the subject and enables an in depth understanding of seismic inversion This book also provides a practical guide to reservoir geophysicists who are attempting quantitative reservoir characterisation based on seismic data Philosophically the seismic inverse problem allows for a range of possible solutions but the techniques described herein enable geophysicists to exclude models that cannot satisfy the available data This book summarises the author s extensive experience in both industry and academia and includes innovative techniques not previously published Seismic Inverse Q Filtering Yanghua Wang,2009-01-26 Seismic inverse Q filtering is a data processing technology for enhancing the resolution of seismic images It employs a wave propagation reversal procedure that compensates for energy absorption and corrects wavelet distortion due to velocity dispersion By compensating for amplitude attenuation seismic data can provide true relative amplitude information for amplitude inversion and subsequent reservoir characterization By correcting the phase distortion seismic data with enhanced vertical resolution can yield correct timings for lithological identification This monograph presents the theory of inverse Q filtering and a series of algorithms collected with the following selection criteria in mind robustness effectiveness and practicality The book is written for processing geophysicists who are attempting to improve the quality of seismic data in terms of resolution and signal to noise ratio as well as for reservoir geophysicists who are concerned about seismic fidelity in terms of true amplitudes true timings and true frequencies It will also be particularly valuable as a guide for seasoned geophysicists who are attempting to develop seismic software for various research settings Finally it can be used as a reference work or textbook for postgraduate students in seismic and reservoir geophysics *Seismic Stratigraphy, Basin Analysis and Reservoir Characterisation* P.C.H. Veeken,2006-11-13 The interest in seismic stratigraphic techniques to interpret reflection

datasets is well established The advent of sophisticated subsurface reservoir studies and 4D monitoring for optimising the hydrocarbon production in existing fields does demonstrate the importance of the 3D seismic methodology The added value of reflection seismics to the petroleum industry has clearly been proven over the last decades Seismic profiles and 3D cubes form a vast and robust data source to unravel the structure of the subsurface It gets nowadays exploited in ever greater detail Larger offsets and velocity anisotropy effects give for instance access to more details on reservoir flow properties like fracture density porosity and permeability distribution Elastic inversion and modelling may tell something about the change in petrophysical parameters Seismic investigations provide a vital tool for the delineation of subtle hydrocarbon traps They are the basis for understanding the regional basin framework and the stratigraphic subdivision Seismic stratigraphy combines two very different scales of observation the seismic and well control The systematic approach applied in seismic stratigraphy explains why many workers are using the principles to evaluate their seismic observations The here presented modern geophysical techniques allow more accurate prediction of the changes in subsurface geology Dynamics of sedimentary environments are discussed with its relation to global controling factors and a link is made to high resolution sequence stratigraphy Seismic Stratigraphy Basin Analysis and Reservoir Characterisation summarizes basic seismic interpretation techniques and demonstrates the benefits of intergrated reservoir studies for hydrocarbon exploration Topics are presented from a practical point of view and are supported by well illustrated case histories The reader student as well as professional geophysicists geologists and reservoir engineers is taken from a basic level to more advanced study techniques Overview reflection seismic methods and its limitations Link between basic seismic stratigraphic principles and high resolution sequence stratigraphy Description of various techniques for seismic reservoir characterization and synthetic modelling Overview nversion techniques AVO and seismic attributes analysis Handbook of Signal Processing in Acoustics David Havelock,Sonoko Kuwano,Michael Vorländer,2008-10-26 The Handbook of Signal Processing in Acoustics brings together a wide range of perspectives from over 100 authors to reveal the interdisciplinary nature of the subject It brings the key issues from both acoustics and signal processing into perspective and is a unique resource for experts and practitioners alike to find new ideas and techniques within the diversity of signal processing in acoustics Seismic Waves and Rays in Elastic Media M.A. Slawinski,2003-08-04 This book seeks to explore seismic phenomena in elastic media and emphasizes the interdependence of mathematical formulation and physical meaning The purpose of this title which is intended for senior undergraduate and graduate students as well as scientists interested in quantitative seismology is to use aspects of continuum mechanics wave theory and ray theory to describe phenomena resulting from the propagation of waves The book is divided into three parts Elastic continua Waves and rays and Variational formulation of rays In Part I continuum mechanics are used to describe the material through which seismic waves propagate and to formulate a system of equations to study the behaviour of such material In Part II these equations are used to identify the types of body waves propagating in elastic

continua as well as to express their velocities and displacements in terms of the properties of these continua To solve the equations of motion in anisotropic inhomogeneous continua the high frequency approximation is used and establishes the concept of a ray In Part III it is shown that in elastic continua a ray is tantamount to a trajectory along which a seismic signal propagates in accordance with the variational principle of stationary travel time **Advances in Geophysics** ,2003-12-11 The critically acclaimed serialized review journal for nearly fifty years Advances in Geophysics is a highly respected publication in the field of geophysics Since 1952 each volume has been eagerly awaited frequently consulted and praised by researchers and reviewers alike Now with over 45 volumes the Serial contains much material still relevant today truly an essential publication for researchers in all fields of geophysics *Information-Based Inversion and Processing with Applications* T.J. Ulrych,M.D. Sacchi,2005-12-16 Information Based Inversion and Processing with Applications examines different classical and modern aspects of geophysical data processing and inversion with emphasis on the processing of seismic records in applied seismology Chapter 1 introduces basic concepts including probability theory expectation operator and ensemble statistics elementary principles of parameter estimation Fourier and z transform essentials and issues of orthogonality In Chapter 2 the linear treatment of time series is provided Particular attention is paid to Wold decomposition theorem and time series models AR MA and ARMA and their connection to seismic data analysis problems Chapter 3 introduces concepts of Information theory and contains a synopsis of those topics that are used throughout the book Examples are entropy conditional entropy Burg s maximum entropy spectral estimator and mutual information Chapter 4 provides a description of inverse problems first from a deterministic point of view then from a probabilistic one Chapter 5 deals with methods to improve the signal to noise ratio of seismic records Concepts from previous chapters are put in practice for designing prediction error filters for noise attenuation and high resolution Radon operators Chapter 6 deals with the topic of deconvolution and the inversion of acoustic impedance The first part discusses band limited extrapolation assuming a known wavelet and considers the issue of wavelet estimation The second part deals with sparse deconvolution using various entropy type norms Finally Chapter 7 introduces recent topics of interest to the authors The emphasis of this book is on applied seismology but researchers in the area of global seismology and geophysical signal processing and inversion will find material that is relevant to the ubiquitous problem of estimating complex models from a limited number of noisy observations Non conventional approaches to data processing and inversion are presented Important problems in the area of seismic resolution enhancement are discussed Contains research material that could inspire graduate students and their supervisors to undertake new research directions in applied seismology and geophysical signal processing **Wave Fields in Real Media** José M. Carcione,2007-01-24 Wave Fields in Real Media examines the differences between an ideal and a real description of wave propagation where ideal means an elastic lossless isotropic and single phase medium and real means an anelastic anisotropic and multi phase medium The analysis starts by introducing the relevant stress strain relation

This relation and the equations of momentum conservation are combined to give the equation of motion The differential formulation is written in terms of memory variables and Biot s theory is used to describe wave propagation in porous media For each rheology a plane wave analysis is performed in order to understand the physics of wave propagation The book contains a review of the main direct numerical methods for solving the equation of motion in the time and space domains The emphasis is on geophysical applications for seismic exploration but researchers in the fields of earthquake seismology rock acoustics and material science including many branches of acoustics of fluids and solids may also find this text useful Presents the fundamentals of wave propagation in anisotropic anelastic and porus media Contains a new chapter on the analogy between acoustic and electromagnetic waves incorporating the subject of electromagnetic waves Emphasizes geophysics particularly seismic exploration for hydrocarbon reservoirs which is essential for exploration and production of oil

Fractal Models in Exploration Geophysics V.P. Dimri,R.P. Srivastava,Nimisha Vedanti,2012-10-22 Researchers in the field of exploration geophysics have developed new methods for the acquisition processing and interpretation of gravity and magnetic data based on detailed investigations of bore wells around the globe Fractal Models in Exploration Geophysics describes fractal based models for characterizing these complex subsurface geological structures The authors introduce the inverse problem using a fractal approach which they then develop with the implementation of a global optimization algorithm for seismic data very fast simulated annealing VFSA This approach provides high resolution inverse modeling results particularly useful for reservoir characterization Serves as a valuable resource for researchers studying the application of fractals in exploration and for practitioners directly applying field data for geo modeling Discusses the basic principles and practical applications of time lapse seismic reservoir monitoring technology application rapidly advancing topic Provides the fundamentals for those interested in reservoir geophysics and reservoir simulation study Demonstrates an example of reservoir simulation for enhanced oil recovery using CO2 injection **Quantitative Borehole Acoustic Methods** X.M. Tang,Chuen Hon Arthur Cheng,2004-01-27 Acoustic logging is a multidisciplinary technology involving basic theory instrumentation and data processing interpretation methodologies The advancement of the technology now allows for a broad range of measurements to obtain formation properties such as elastic wave velocity and attenuation formation permeability and seismic anisotropy that are important for petroleum reservoir exploration With these advances it is easier to detect and characterize formation fractures estimate formation stress field and locate estimate petroleum reserves The technology has evolved from the monopole acoustic logging into the multipole including dipole cross dipole and even quadrupole acoustic logging measurements The measurement process has developed from the conventional wireline logging into the logging while drilling stage For such a fast developing technology with applications that are interesting to readers of different backgrounds it is necessary to have systematic documentation of the discipline including the theory methods and applications as well as the technology s past present and near future development trends Quantitative Borehole Acoustic

Methods provides such documentation with emphasis on the development over the past decade Although considerable effort has been made to provide a thorough basis for the theory and methodology development emphasis is placed on the applications of the developed methods The applications are illustrated with field data examples Many of the acoustic waveform analysis processing methods described in the book are now widely used in the well logging industry **Coding and Decoding: Seismic Data** Luc T. Ikelle,2010-03-29 Currently the acquisition of seismic surveys is performed as a sequential operation in which shots are computed separately one after the other This approach is similar to that of multiple access technology which is widely used in cellular communications to allow several subscribers to share the same telephone line The cost of performing various shots simultaneously is almost identical to that of one shot thus the savings in time and money expected from using the multishooting approach for computing seismic surveys compared to the current approach are enormous By using this approach the long standing problem of simulating a three dimensional seismic survey can be reduced to a matter of weeks and not years as is currently the case Investigates how to collect stimulate and process multishooting data Addresses the improvements in seismic characterization and resolution one can expect from multishooting data Aims to educate the oil and gas exploration and production business of the benefits of multishooting data and to influence their day to day surveying techniques **Tomographic Inversion of Reflection Seismic Amplitude Data for Interface Geometry and Velocity Variation** Yanghua Wang,1994 **Seismic While Drilling** F.B Poletto,F. Miranda,2004-06-30 The purpose of this book is to give a theoretical and practical introduction to seismic while drilling by using the drill bit noise This recent technology offers important products for geophysical control of drilling It involves aspects typical of borehole seismics and of the drilling control surveying hitherto the sole domain of mudlogging For aspects related to the drill bit source performance and borehole acoustics the book attempts to provide a connection between experts working in geophysics and in drilling There are different ways of thinking related to basic knowledge operational procedures and precision in the observation of the physical quantities The goal of the book is to help build a bridge between geophysicists involved in seismic while drilling who may need to familiarize themselves with methods and procedures of drilling and drilling rock mechanics and drillers involved in geosteering and drilling of smart wells who may have to familiarize themselves with seismic signals wave resolution and radiation For instance an argument of common interest for drilling and seismic while drilling studies is the monitoring of the drill string and bit vibrations This volume contains a large number of real examples of SWD data analysis and applications Advanced Intelligent Computing Technology and Applications De-Shuang Huang,Bo Li,Haiming Chen,Chuanlei Zhang,2025-07-25 The 20 volume set LNCS 15842 15861 together with the 4 volume set LNAI 15862 15865 and the 4 volume set LNBI 15866 15869 constitutes the refereed proceedings of the 21st International Conference on Intelligent Computing ICIC 2025 held in Ningbo China during July 26 29 2025 The 1206 papers presented in these proceedings books were carefully reviewed and selected from 4032 submissions They deal with emerging and challenging

topics in artificial intelligence machine learning pattern recognition bioinformatics and computational biology **Methods and Applications in Reservoir Geophysics** David H. Johnston,Michael R. Cooper,2010 Methods and Applications in Reservoir Geophysics SEG Investigations in Geophysics No 15 not only demonstrates the value of geophysics in reservoir management but also shows how to apply geophysical technologies more effectively in reservoir studies The chapter editors have selected more than 40 papers from SEG and other journals and have added 13 new contributions In the reservoir engineering tutorial geophysicists will discover a rich source of information on issues and data that are critically important to the engineer In the geophysics tutorial the engineer and the geophysicist will find explanations of the tools and data discussed in the book s case studies Each chapter then focuses on a different phase of field life exploration appraisal development planning and production optimization Geophysics is used in each of those stages to help address the critical technical issues and business decisions that the reservoir management team faces The case studies demonstrate the processes methods and techniques used in reservoir geophysics not simply the results The last chapter explores the road ahead and emerging technologies that define the future of reservoir geophysics This book will be valuable for geophysicists engineers and all members of the reservoir management team who want to ensure that the correct data are used to maximize reserves optimize recovery and contain costs Active Geophysical Monitoring ,2010-03-05 Active geophysical monitoring is an important new method for studying time evolving structures and states in the tectonically active Earth s lithosphere It is based on repeated time lapse observations and interpretation of rock induced changes in geophysical fields periodically excited by controlled sources In this book the results of strategic systematic development and the application of new technologies for active geophysical monitoring are presented The authors demonstrate that active monitoring may drastically change solid Earth geophysics through the acquisition of substantially new information based on high accuracy and real time observations Active monitoring also provides new means for disaster mitigation in conjunction with substantial international and interdisciplinary cooperation Introduction of a new concept Most experienced authors in the field Comprehensiveness

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