Introduction to Numerical Methods for Time Dependent Differential Equations

Where To Download Numerical Solution Wave Equation

cce646033bca874d8dc3baee3c865fe2c

Introduction to Numerical Methods for Time Dependent Differential Equations

On the Numerical Solution of a Functional Differential Equation Pertaining to a Wave Equation

Higher-Order Numerical Methods for Transient Wave Equations

A Numerical Solution of the Second-Order-Nonlinear Acoustic Wave Equation in One and in Three Dimensions

An adaptive approach to the numerical solution of Fresnel's wave equation

Fortran Program for the Numerical Solution of the Schrödinger Wave Equation

Numerical Methods for Simulation of Diffusion and Wave Propagation

Analytical and Numerical Methods for Wave Propagation in Fluid Media

Meshless Space-time Method to Solve Two-dimensional Wave Equation

A Numerical Method For

Extended Boussinesq Shallow-Water Wave Equations

Numerical Solution of an Inverse Problem of the Nonlinear Wave Equation with the Aid of Regularization

Numerical Solution of the Wave Equation in Unbounded Domains

Bounded Error Schemes for the Wave Equation on Complex Domains

A Numerical Method for the Wave Equation

Numerical Analysis of Partial Differential Equations Using Maple and MATLAB

The Numerical Solution of a Nonlinear Wave Equation from Solid State Physics

Numerical Solution of the 2D Wave Equation for Inhomogeneous and Arbitrary Anisotropic Media by a Fourier Transform Method

Error Bound on a Numerical Solution of the Quasi-linear Wave Equation

Numerical Solutions of the Nonlinear Scalar Wave Equation as a Characteristic Initial Value Problem

Finite Element and Discontinuous Galerkin Methods for Transient Wave Equations

Error Bound on a Numerical Solution of the Quasi-linear Wave Equation

Numerical Methods for Boundary Value Problems with Applications to the Wave Equation

Full Seismic Waveform Modelling and Inversion

Numerical Methods for Wave Equations in Geophysical Fluid Dynamics

Numerical Methods for Boundary Value Problems with Application to the Wave Equation

Parabolic Wave Equations with Applications

Depth Migration of Seismic Data by Numerical Solution of the Wave Equation

Numerical Methods for Problems in Infinite Domains

Partial Differential Equations

Numerical Methods for Nonlinear Wave Propagation in Ultrasound

A Numerical Solution of the Schroedinger Wave Equation

A Note on Discontinuous Numerical Solutions of the Kinematic Wave Equation

Klassische Elektrodynamik

Numerical Methods for Engineers and Scientists, Second Edition

Bounded Error Schemes for the Wave Equation on Complex Domains

On Finite Difference Methods for the Numerical Solution of the Wave Equation in First-order System Form

Numerical Solutions of Schroedinger Wave Equation for X4 Potential

Numerical Solution of Full-wave Equation with Mode-coupling

Numerical Solution of the Schrodinger Wave Equation in a Potential Well

Introduction to Numerical Methods for Time Dependent Differential Equations

The accurate numerical simulation of wave disturbance within harbours requires consideration of both nonlinear and dispersive wave processes in order to capture such physical effects as wave refraction and diffraction, and nonlinear wave interactions such as the generation of harmonic waves. The Boussinesq equations are the simplest class of mathematical model that contain all these effects in a variable depth, shallow water environment. There are a variety of Boussinesq-type mathematical models and it is necessary to compare and contrast them both for their limitations with respect to the physical parameters of the problem and also for their ease of application as part of a suitable numerical model. It is decided here to consider a set of extended Boussinesq equations which provide an accurate model of the wave processes over a greater range of depths than the classical Boussinesq mathematical model. A method-of-lines numerical algorithm is proposed for these problems, combining a finite element spatial discretisation with existing, adaptive order, adaptive step size time integration software. Two simpler one-dimensional, nonlinear, dispersive wave models; the Korteweg-de Vries equation and Regularised Long Wave equation, are used in the initial development of the numerical methods. It is shown that within the
shallow water framework a linear finite element method is sufficiently accurate for these problems. This numerical method is then applied to the one-dimensional extended Boussinesq equations. It is shown how the previously developed method can be directly used and that it is of similar accuracy to a previously published finite difference method. Initial conditions and boundary conditions are described in detail taking into account physical, mathematical and computational considerations. A new formulation of internal wave generation is developed which allows reflected waves to pass through the wave generation region. The performance of the numerical model is demonstrated by comparison against theoretical results, a previously published finite difference model and experimental results. The two-dimensional extended Boussinesq equation system is rewritten in a form suitable for the application of a linear triangular finite element spatial discretisation. The formulation of appropriate initial and boundary conditions in combination with the application of the time integration software to this equation system is considered in detail. The performance of the numerical method is tested by comparison with experimental data and the suitability of the model for harbour design is investigated by simulation of a realistic harbour geometry and wave conditions.

On the Numerical Solution of a Functional Differential Equation Pertaining to a Wave Equation

Higher-Order Numerical Methods for Transient Wave Equations

A Numerical Solution of the Second-Order-Nonlinear Acoustic Wave Equation in One and in Three Dimensions

An adaptive approach to the numerical solution of Fresnel's wave equation

Fortran Program for the Numerical Solution of the Schrödinger Wave Equation A new method for the numerical solution of the wave equation governing the propagation of electromagnetic waves in a horizontally stratified, inhomogeneous, anisotropic layer is described. The wave equation is a homogeneous set of four linear differential equations of the first order. In the computer calculation, all singularities of the wave equation are removed in practical cases and a proper step-size based on the gradients of the medium properties is programmed automatically. The multiplicative nature of the solutions facilitates the procedure. Modification of solutions from one height to another is expressed in explicit form on the assumption that the propagation tensor varies linearly with height in each step of integration. In the mathematical development, matrix operations are extensively used in order to achieve a general representation. Four independent solutions of the wave equation are derived. During an ordinary integration for an inhomogeneous medium, a degradation occurs inevitably in the degree of linear independence among special solutions. This cause is analyzed. To obtain a complete set of special solutions with good linear independence, a particular device is developed for general applications. This method has been programmed for computer calculation by an IBM 7090. The resultant wave fields and wave polarizations for the independent modes are shown for a model ionosphere. The resultant wave is described as a 'scrambling' of four characteristic waves. The 'scrambling' state is visualized at each height. (Author).

Numerical Methods for Simulation of Diffusion and Wave Propagation Development of numerical methods to solve partial differential equations is extremely important as most of the real life physical systems can be formulated in the form of these. By solving partial differential equations, the characteristics of a physical system can be simulated even without performing laboratory experiments. This book discusses the development of few efficient numerical tools to solve diffusion and wave equation. Methods for treating diffusion of atoms, molecules, ions and charge carriers in solid state and optoelectronic structures are presented. Additionally, split-step based numerical method for bi-directional wave propagation is presented. This method requires only matrix multiplications at each step.
and no inversion or diagonalization is required. The numerical tools presented in the book are applied to analyze numerous diffusion and wave propagation based processes.

Analytical and Numerical Methods for Wave Propagation in Fluid Media

Meshless Space-time Method to Solve Two-dimensional Wave Equation

This paper considers the application of the method of boundary penalty terms ("SAT") to the numerical solution of the wave equation on complex shapes with Dirichlet boundary conditions. A theory is developed, in a semi-discrete setting, that allows the use of a Cartesian grid on complex geometries, yet maintains the order of accuracy with only a linear temporal error-bound. A numerical example, involving the solution of Maxwell's equations inside a 2-D circular wave-guide demonstrates the efficacy of this method in comparison to others (e.g. the staggered Yee scheme) - we achieve a decrease of two orders of magnitude in the level of the L2-error. Abarbanel, Saul and Ditkowski, Adi and Yefet, Amir Langley Research Center NASA/CR-1998-208740, NAS 1.26:208740, ICASE-98-50 NAS1-19480; NAS1-97046; F49620-95-I-0074; DE-FG02-95ER-25239; RTOP 505-90-52-01

A Numerical Method For Extended Boussinesq Shallow-Water Wave Equations

Numerical Solution of an Inverse Problem of the Nonlinear Wave Equation with the Aid of Regularization

Meshless methods utilizing Radial Basis Functions (RBF) have been widely used to find numerical solutions for Partial Differential Equations (PDEs). Unlike the other numerical methods, meshless algorithms are significantly simpler to implement as they do not require a mesh in the simulation domain. Rolland L. Hardy, an Iowa State geodesist, was the first to study using RBF for scattered data interpolations in the early 1970s. He introduced his Multiquadric (MQ) RBF, which has been used to obtain numerical solutions for various types of RBF interpolation problems. In addition to that, E. J. Kansa, in the very early 1990s, made the first attempt to extend RBF interpolation to obtain solutions for PDEs. In this thesis, we propose a numerical scheme, which has been based on Kansa's method, to solve time-dependent PDEs. In contrast to already existing methods for solving time-dependent PDEs, our model treats the time variable the same as a spatial variable. However, the accuracy of the RBF numerical methods highly depends on the shape parameter, c, which is associated with the RBF. The value of the c that guarantees the highest accuracy is problem dependent and it is called as the optimal value of c. Even with the optimal value of c, it is not possible to achieve a significantly high accuracy compared to existing methods. In order to enhance the level of accuracy, we introduce "Ghost Points" into the computational domain. While traditional RBF based numerical methods place the centers exclusively inside the computational domain, the ghost point approach expands the region of the centers inside and outside the computational domain. Our numerical results suggest that the accuracy of the numerical results has been significantly increased by the ghost points.

Numerical Solution of the Wave Equation in Unbounded Domains

Bounded Error Schemes for the Wave Equation on Complex Domains

This monograph presents numerical methods for solving transient wave equations (i.e. in time domain). More precisely, it provides an overview of continuous and discontinuous finite element methods for these equations, including their implementation in physical models, an extensive description of 2D and 3D elements with different shapes, such as prisms or pyramids, an analysis of the accuracy of the methods and the study of the Maxwell’s system and the important problem of its spurious free approximations. After recalling the classical models, i.e. acoustics, linear elastodynamics and electromagnetism and their variational formulations, the authors present a wide variety of finite elements of different shapes useful for the numerical resolution of wave equations. Then, they focus on the construction of efficient continuous and discontinuous Galerkin methods and study their accuracy by plane wave techniques and a priori error
estimates. A chapter is devoted to the Maxwell’s system and the important problem of its spurious-free approximations. Treatment of unbounded domains by Absorbing Boundary Conditions (ABC) and Perfectly Matched Layers (PML) is described and analyzed in a separate chapter. The two last chapters deal with time approximation including local time-stepping and with the study of some complex models, i.e. acoustics in flow, gravity waves and vibrating thin plates. Throughout, emphasis is put on the accuracy and computational efficiency of the methods, with attention brought to their practical aspects. This monograph also covers in details the theoretical foundations and numerical analysis of these methods. As a result, this monograph will be of interest to practitioners, researchers, engineers and graduate students involved in the numerical simulation of waves.

A Numerical Method for the Wave Equation This volume reviews and discusses the main numerical methods used today for solving problems in infinite domains. It also presents in detail one very effective method in this class, namely the Dirichlet-to-Neumann (DtN) finite element method. The book is intended to provide the researcher or engineer with the state-of-the-art in numerical solution methods for infinite domain problems, such as the problems encountered in acoustics and structural acoustics, fluid dynamics, meteorology, and many other fields of application. The emphasis is on the fundamentals of the various methods, and on reporting recent progress and forecasting future directions. An appendix at the end of the book provides an introduction to the essentials of the finite element method, and suggests a short list of texts on the subject which are categorized by their level of mathematics.

Numerical Analysis of Partial Differential Equations Using Maple and MATLAB

The Numerical Solution of a Nonlinear Wave Equation from Solid State Physics

Numerical Solution of the 2D Wave Equation for Inhomogeneous and Arbitrary Anisotropic Media by a Fourier Transform Method Emphasizing the finite difference approach for solving differential equations, the second edition of Numerical Methods for Engineers and Scientists presents a methodology for systematically constructing individual computer programs. Providing easy access to accurate solutions to complex scientific and engineering problems, each chapter begins with objectives, a discussion of a representative application, and an outline of special features, summing up with a list of tasks students should be able to complete after reading the chapter- perfect for use as a study guide or for review. The AIAA Journal calls the book "a good, solid instructional text on the basic tools of numerical analysis."

Error Bound on a Numerical Solution of the Quasi-linear Wave Equation

Numerical Solution of Partial Differential Equations--Wave Equation

Numerical Solutions of the Nonlinear Scalar Wave Equation as a Characteristic Initial Value Problem

Finite Element and Discontinuous Galerkin Methods for Transient Wave Equations This book introduces parabolic wave equations, their key methods of numerical solution, and applications in seismology and ocean acoustics. The parabolic equation method provides an appealing combination of accuracy and efficiency for many nonseparable wave propagation problems in geophysics. While the parabolic equation method was pioneered in the 1940s by Leontovich and Fock who applied it to radio wave propagation in the atmosphere, it thrived in the 1970s due to its usefulness in seismology and ocean acoustics. The book covers progress made following the parabolic equation’s ascendancy in geophysics. It begins with the necessary preliminaries on the elliptic wave equation and its analysis from which the parabolic wave equation is derived and introduced. Subsequently, the authors demonstrate the use of rational approximation techniques, the Padé solution in particular, to find numerical solutions to the energy-conserving parabolic equation, three-dimensional parabolic equations, and horizontal wave
equations. The rest of the book demonstrates applications to seismology, ocean acoustics, and beyond, with coverage of elastic waves, sloping interfaces and boundaries, acousto-gravity waves, and waves in poro-elastic media. Overall, it will be of use to students and researchers in wave propagation, ocean acoustics, geophysical sciences and more.

Error Bound on a Numerical Solution of the Quasi-linear Wave Equation

Numerical Methods for Boundary Value Problems with Applications to the Wave Equation

Full Seismic Waveform Modelling and Inversion This book provides an elementary yet comprehensive introduction to the numerical solution of partial differential equations (PDEs). Used to model important phenomena, such as the heating of apartments and the behavior of electromagnetic waves, these equations have applications in engineering and the life sciences, and most can only be solved approximately using computers. Numerical Analysis of Partial Differential Equations Using Maple and MATLAB provides detailed descriptions of the four major classes of discretization methods for PDEs (finite difference method, finite volume method, spectral method, and finite element method) and runnable MATLAB code for each of the discretization methods and exercises. It also gives self-contained convergence proofs for each method using the tools and techniques required for the general convergence analysis but adapted to the simplest setting to keep the presentation clear and complete. This book is intended for advanced undergraduate and early graduate students in numerical analysis and scientific computing and researchers in related fields. It is appropriate for a course on numerical methods for partial differential equations.

Numerical Methods for Wave Equations in Geophysical Fluid Dynamics A fresh, forward-looking undergraduate textbook that treats the finite element method and classical Fourier series method with equal emphasis.

Numerical Methods for Boundary Value Problems with Application to the Wave Equation Abstract: "We introduce a method, constructed such that numerical solutions of the wave equation are well behaved also when the solutions contain discontinuities. The wave equation serves as a model problem for the Euler equations when the solution contains a contact discontinuity. Numerical computations of the wave equation in 1D, the Euler equations in 1D and the wave equation with variable coefficients in 2D are presented."

Parabolic Wave Equations with Applications

Depth Migration of Seismic Data by Numerical Solution of the Wave Equation

Numerical Methods for Problems in Infinite Domains "To my knowledge [this] is the first book to address specifically the use of high-order discretizations in the time domain to solve wave equations. [...] I recommend the book for its clear and cogent coverage of the material selected by its author." --Physics Today, March 2003

Partial Differential Equations

Numerical Methods for Nonlinear Wave Propagation in Ultrasound The intensities associated with the propagation of diagnostic and therapeutic ultrasound pulses are large enough to require a nonlinear description. As a nonlinear wave propagates it distorts, creating harmonics and eventually acoustic shocks. Harmonics can be used to generate images with improved spatial resolution and less clutter. The energy from nonlinear waves is deposited in a different way than in the linear case which modifies
predictions for in situ acoustic exposure. Tissue heating and radiation force depend on this intensity. High intensity shock waves are essential for stone comminution with lithotripsy because it depends on the shear gradients caused by the pressure differentials and on the peak negative pressures for cavitation. The work presented in this dissertation investigates numerical simulations that solve nonlinear ultrasonic wave propagation in both the strongly nonlinear regime, where shocks develop, and the weakly nonlinear regime, where the acoustic attenuation prevents the formation of pressure discontinuities. The Rankine-Hugoniot relation for shock wave propagation describes the shock speed of a nonlinear wave. This dissertation investigates time domain numerical methods that solve the nonlinear parabolic wave equation, or the Khokhlov-Zabolotskaya-Kuznetsov (KZK) equation, and the conditions they require to satisfy the Rankine-Hugoniot relation. Two numerical methods commonly used in hyperbolic conservation laws are adapted to solve the KZK equation: Godunov's method and the monotonic upwind scheme for conservation laws (MUSCL). It is shown that they satisfy the Rankine-Hugoniot relation regardless of attenuation. These two methods are compared with the current implicit solution based method. When the attenuation is small, such as in water, the current method requires a degree of grid refinement that is computationally impractical. All three numerical methods are compared in simulations for lithotripters and high intensity focused ultrasound (HIFU) where the attenuation is small compared to the nonlinearity because much of the propagation occurs in water. The simulations are performed on grid sizes that are consistent with present-day computational resources but are not sufficiently refined for the current method to satisfy the Rankine-Hugoniot condition. It is shown that satisfying the Rankine-Hugoniot conditions has a significant impact on metrics relevant to lithotripsy (such as peak pressures), and HIFU (intensity). Because the Godunov and MUSCL schemes satisfy the Rankine-Hugoniot conditions on coarse grids they are particularly advantageous for three dimensional simulations. The propagation of focused and intense ultrasound beams is determined by nonlinearity, diffraction, and absorption. Most descriptions of nonlinear wave propagation in ultrasound, such as the KZK equation, rely on quadratic nonlinearity. At diagnostic and some therapeutic amplitudes the quadratic, or B/A, term dominates the nonlinear term. However, when the amplitudes are sufficiently large, such as in shock wave lithotripsy, the cubic, or C/A, term becomes significant. Conventionally the parabolic wave equation has only included the quadratic terms. This dissertation establishes a time domain numerical method that solves the parabolic wave equation with cubic nonlinearity in an attenuating medium. The differences between solutions of the quadratic and cubic equations for a focused lithotripter in a water bath are investigated. A study of numerical solutions to the linear full-wave equation and the KZK or parabolic wave equation is presented. Finite difference time domain methods are used to calculate the acoustic field emitted from a diagnostic ultrasound transducer. Results are compared to Field II, a simulation package that has been used extensively to linearly model transducers in ultrasound. The simulation of the parabolic equation can accurately predict the lateral beamplot for large F-numbers but exhibits errors for small F-numbers. It also overestimates the depth at which the focus occurs. It is shown that the finite difference solution of the full-wave equation is accurate for small and large F-numbers. The lateral beamplots and axial intensities are in excellent agreement with the Field II simulations. For these reasons the KZK equation is abandoned in favor of the full-wave equation to describe nonlinear propagation for ultrasound imaging. A full-wave equation that describes nonlinear propagation in a heterogeneous attenuating medium is solved numerically with finite differences in the time domain (FDTD). Three dimensional solutions of the equation are verified with water tank measurements of a commercial diagnostic ultrasound transducer and are shown to be in excellent agreement in terms of the fundamental and harmonic acoustic fields, and the power spectrum at the focus. The linear and nonlinear components of the algorithm are also verified independently. In the linear non-attenuating regime solutions match simulations from Field II to within 0.3 dB. Nonlinear plane wave propagation is shown to closely match results from the Galerkin method up to four times the fundamental frequency. In addition to thermoviscous attenuation we present a numerical solution of the relaxation attenuation laws that allows modeling of arbitrary frequency dependent attenuation, such as that observed in tissue. A perfectly matched layer (PML) is implemented at the boundaries with a novel
numerical implementation that allows the PML to be used with high order discretizations. A -78 dB reduction in the reflected amplitude is demonstrated. The numerical algorithm is used to simulate a diagnostic ultrasound pulse propagating through a histologically measured representation of human abdominal wall with spatial variation in the speed of sound, attenuation, nonlinearity, and density. An ultrasound image is created in silico using the same physical and algorithmic process used in an ultrasound scanner: a series of pulses are transmitted through heterogeneous scattering tissue and the received echoes are used in a delay-and-sum beamforming algorithm to generate images. The resulting harmonic image exhibits characteristic improvement in lesion boundary definition and contrast when compared to the fundamental image. We demonstrate a mechanism of harmonic image quality improvement by showing that the harmonic point spread function is less sensitive to reverberation clutter. Numerical solutions of the nonlinear full-wave equation in a heterogeneous attenuating medium are used to simulate the propagation of diagnostic ultrasound pulses through a measured representation of the human abdomen with heterogeneities in speed of sound, attenuation, density, and nonlinearity. Conventional delay-and-sum beamforming is used to generate point spread functions (PSF) from a point target located at the focus. These PSFs reveal that, for the particular imaging system considered, the primary source of degradation in fundamental imaging is due to reverberation from near-field structures. Compared to the harmonic PSF the mean magnitude of the reverberation clutter in the fundamental PSF is 26 dB higher. An artificial medium with uniform velocity but unchanged impedance characteristics is used to show that for the fundamental PSF the primary source of degradation is phase aberration. Ultrasound images are created in silico and these beamformed images are compared to images obtained from convolution of the PSF with a scatterer field to demonstrate that a very large portion of the PSF must be used to accurately represent the clutter observed in conventional imaging. Conventional delay-and-sum beamforming is used to generate images of an anechoic lesion located beneath the abdominal layer for various transducer configurations. Point spread functions (PSF) and estimates of the contrast to noise ratio (CNR) are used to quantify and determine the sources of improvement between harmonic and fundamental imaging. Simulations indicate that reducing the pressure amplitude at the transducer surface has no discernible effect on image quality. It is shown that when the aperture is reduced there is an increase in the image degradation due to reverberation clutter in the fundamental and an increase in the effects of reverberation and phase aberration in the harmonic. A doubling of the transmit frequency shows that the harmonic lesion CNR becomes worse than the fundamental CNR due to increases in pulse lengthening and phase aberration. Acoustic Radiation Force Impulse (ARFI) imaging uses brief, high intensity, focused ultrasound pulses to generate a radiation force that displaces tissue. Nonlinear propagation of acoustic pulses transfers energy to higher frequencies where it is preferentially absorbed by tissue. The radiation force is proportional to the absorbed energy. This dissertation examines the effects of nonlinearity on the displacements induced by radiation force with various ultrasound transducer configurations. A three dimensional numerical method that simulates nonlinear acoustic propagation is used to calculate the intensity and absorption losses for typical ARFI pulses. It is demonstrated that nonlinearity has a relatively small effect on the intensity but increases estimates of the loss by up to a factor of 20. The intensity fields obtained from the acoustic simulations are used as an input to a finite element method (FEM) model of the mechanical tissue response to a radiation force excitation. These simulations show that including nonlinearity in the acoustic intensity significantly reduces predictions of the displacement without having a significant impact on the lateral and elevation resolution.

A Numerical Solution of the Schroedinger Wave Equation Covering a wide range of techniques, this book describes methods for the solution of partial differential equations which govern wave propagation and are used in modeling atmospheric and oceanic flows. The presentation establishes a concrete link between theory and practice.

A Note on Discontinuous Numerical Solutions of the Kinematic Wave Equation
The effects of moderate nonlinearity on the propagation of sound are appreciable, and become dominant at very high amplitudes. These effects and the phenomena of linear acoustics are described by the second-order-nonlinear wave equation, which is derived in this thesis and solved by numerical means. The validity of the solution is demonstrated by its agreement with various approximations in their domains of applicability, and by its reproduction of results derived from experiments. Using the numerical solution in simulation of the operation of acoustic transducers at finite amplitudes, conclusions are presented concerning the amount of energy that may be transmitted to the far field by various types of signals. (Author).

Numerical Methods for Engineers and Scientists, Second Edition,

Bounded Error Schemes for the Wave Equation on Complex Domains This book surveys analytical and numerical techniques appropriate to the description of fluid motion with an emphasis on the most widely used techniques exhibiting the best performance. Analytical and numerical solutions to hyperbolic systems of wave equations are the primary focus of the book. In addition, many interesting wave phenomena in fluids are considered using examples such as acoustic waves, the emission of air pollutants, magnetohydrodynamic waves in the solar corona, solar wind interaction with the planet venus, and ion-acoustic solitons.

On Finite Difference Methods for the Numerical Solution of the Wave Equation in First-order System Form Recent progress in numerical methods and computer science allows us today to simulate the propagation of seismic waves through realistically heterogeneous Earth models with unprecedented accuracy. Full waveform tomography is a tomographic technique that takes advantage of numerical solutions of the elastic wave equation. The accuracy of the numerical solutions and the exploitation of complete waveform information result in tomographic images that are both more realistic and better resolved. This book develops and describes state of the art methodologies covering all aspects of full waveform tomography including methods for the numerical solution of the elastic wave equation, the adjoint method, the design of objective functionals and optimisation schemes. It provides a variety of case studies on all scales from local to global based on a large number of examples involving real data. It is a comprehensive reference on full waveform tomography for advanced students, researchers and professionals.

Numerical Solutions of Schroedinger Wave Equation for X4 Potential

Numerical Solution of Full-wave Equation with Mode-coupling This paper considers the application of the method of boundary penalty terms (SAT) to the numerical solution of the wave equation on complex shapes with Dirichlet boundary conditions. A theory is developed, in a semi-discrete setting, that allows the use of a Cartesian grid on complex geometries, yet maintains the order of accuracy with only a linear temporal error bound. A numerical example, involving the solution of Maxwell's equations inside a 2-D circular waveguide demonstrates the efficacy of this method in comparison to others (e.g. the staggered Yee scheme) we achieve a decrease of two orders of magnitude in the level of the L2 error.

Numerical Solution of the Schrodinger Wave Equation in a Potential Well Introduces both the fundamentals of time dependent differential equations and their numerical solutions Introduction to Numerical Methods for Time Dependent Differential Equations delves into the underlying mathematical theory needed to solve time dependent differential equations numerically. Written as a self-contained introduction, the book is divided into two parts to emphasize both ordinary differential equations (ODEs) and partial differential equations (PDEs). Beginning with ODEs and their approximations, the authors provide a crucial presentation of fundamental notions, such as the theory of scalar equations, finite difference approximations, and the Explicit Euler method. Next, a discussion on higher order
approximations, implicit methods, multistep methods, Fourier interpolation, PDEs in one space dimension as well as their related systems is provided. Introduction to Numerical Methods for Time Dependent Differential Equations features: A step-by-step discussion of the procedures needed to prove the stability of difference approximations Multiple exercises throughout with select answers, providing readers with a practical guide to understanding the approximations of differential equations A simplified approach in a one space dimension Analytical theory for difference approximations that is particularly useful to clarify procedures Introduction to Numerical Methods for Time Dependent Differential Equations is an excellent textbook for upper-undergraduate courses in applied mathematics, engineering, and physics as well as a useful reference for physical scientists, engineers, numerical analysts, and mathematical modelers who use numerical experiments to test designs or predict and investigate phenomena from many disciplines.

Copyright code: ce646033bca874d8dc3baee3c865fe2c