Solution Of Coupled System Of Nonlinear Differential

Extended Finite Element MethodNumerical Modeling of Coupled Phenomena in Science and EngineeringPhysical Modeling for Virtual Manufacturing Systems and ProcessesA Dimensional Analysis and Numerical Solution of Convection-diffusion in a Coupled SystemExcel Scientific and Engineering CookbookOn the General Solutions of Coupled-mode Equations with Varying CoefficientsCoupled Models for the Hydrological CyclePartial Differential EquationsAlgorithms for the Solution of Systems of Coupled Second Order Ordinary Differential EquationsNonlinear Systems of Partial Differential EquationsSolutions of Nonlinear Schrödinger SystemsPattern Formation in Continuous and Coupled SystemsPerturbation Methods for Engineers and ScientistsThe Structure of the Cauchy Problem Solution for a Coupled System of Equations of Electrodynamics and Elasticity in the Case of Point SourcesNonlinear WavesNonlinear Parabolic-Hyperbolic Coupled Systems and Their AttractorsNonlinear Dynamics and ChaosSynchronization in Coupled Chaotic Circuits and SystemsNonlinear Parabolic Equations and Hyperbolic-Parabolic Coupled SystemsOrdinary Differential EquationsDynamics of Coupled Systems in High-Speed RailwaysDynamical SystemsStrongly Coupled Parabolic and Elliptic SystemsMathematical Modelling with Case StudiesNumerical Solution of Ordinary Differential EquationsKronecker Products and Matrix Calculus with ApplicationsNumerical Solution of the

Coupled System of Nonlinear Fractional Ordinary Differential EquationsComputational Welding MechanicsSymmetry Analysis of Differential Equations with Mathematica®Numerical Data Fitting in Dynamical SystemsControl and Estimation of Distributed Parameter SystemsNumerical Methods for Nonlinear Engineering ModelsNumerical Treatment of Coupled SystemsAsymptotic Behavior of Solutions of Model Problems for a Coupled SystemOn the Steady Motion of a Coupled System Solid-liquidOptimal Control of Coupled Systems of Partial Differential EquationsNumerical Analysis Using RComputational Partial Differential EquationsDynamics of Coupled Map Lattices and of Related Spatially Extended SystemsNumerical Methods for Partial Differential Equations

Extended Finite Element Method

Consisting of 23 refereed contributions, this volume offers a broad and diverse view of current research in control and estimation of partial differential equations. Topics addressed include, but are not limited to - control and stability of hyperbolic systems related to elasticity, linear and nonlinear; - control and identification of nonlinear parabolic systems; - exact and approximate controllability, and observability; - Pontryagin's maximum principle and dynamic programming in PDE; and - numerics pertinent to optimal and suboptimal control problems. This volume is primarily geared toward control theorists seeking information on the latest developments in their area of expertise. It may also serve as a stimulating reader to any researcher who wants to gain an impression of activities at the forefront of a vigorously expanding area in applied mathematics.

Numerical Modeling of Coupled Phenomena in Science and Engineering

This text teaches finite element methods and basic finite difference methods from a computational point of view. It emphasizes developing flexible computer programs using the numerical library Diffpack, which is detailed for problems including model equations in applied mathematics, heat transfer, elasticity, and viscous fluid flow. This edition offers new applications and projects, and all program examples are available on the Internet.

Physical Modeling for Virtual Manufacturing Systems and Processes

The existence and qualitative properties of nontrivial solutions for some important nonlinear Schrödinger systems have been studied in this thesis. For a well-known system arising from nonlinear optics and Bose-Einstein condensates (BEC), in the subcritical case, qualitative properties of ground state solutions, including an optimal parameter range for the existence, the uniqueness and asymptotic behaviors, have been investigated and the results could firstly partially answer open questions raised by Ambrosetti, Colorado and Sirakov. In the critical case, a systematical research on ground state solutions, including the existence, the nonexistence, the uniqueness and the phase separation phenomena of the limit profile has been presented, which seems to be the first contribution for BEC in the critical case. Furthermore, some quite different phenomena were also studied in a more general critical system. For the classical Brezis-Nirenberg critical exponent problem, the sharp energy estimate of least energy solutions in a ball has been investigated in this study. Finally, for Ambrosetti type linearly coupled Schrödinger equations with critical exponent, an optimal result on the existence and nonexistence of ground state solutions for different coupling constants was also obtained in this thesis. These results have many applications in Physics and PDEs.

A Dimensional Analysis and Numerical Solution of Convection-diffusion in a Coupled System

Computational welding mechanics (CWM) provides an important technique for modelling welding processes. Welding simulations are a key tool in improving the design and control of welding processes and the performance of welded components or structures. CWM can be used to model phenomena such as heat generation, thermal stresses and large plastic deformations of components or structures. It also has a wider application in modelling thermomechanical and microstructural phenomena in metals. This important book reviews the principles, methods and applications of CWM. The book begins by discussing the physics of welding before going on to review modelling methods and options as well as validation techniques. It also reviews applications in areas such as fatigue, buckling and deformation, improved service life of components and process optimisation. Some of the numerical methods described in the book are illustrated using software available from the author which allows readers to explore CWM in more depth. Computational welding mechanics is a standard work for welding engineers and all those researching welding processes and wider thermomechanical and microstructural phenomena in metals. Highlights the principles, methods and applications of CWM Discusses the physics of welding Assesses modelling methods and validation techniques

Excel Scientific and Engineering Cookbook

Mathematics is a universal language. Differential equations, mathematical modeling, numerical methods and computation form the underlying infrastructure of engineering and the sciences. In this context mathematical modeling is a very powerful tool for studying engineering problems, natural systems and human society. This interdisciplinary book cont

On the General Solutions of Coupled-mode Equations with Varying Coefficients

Contains contributions originating from the

'Conference on Optimal Control of Coupled Systems of Partial Differential Equations', held at the 'Mathematisches Forschungsinstitut Oberwolfach' in March 2008. This work covers a range of topics such as controllability, optimality systems, model-reduction techniques, and fluid-structure interactions.

Coupled Models for the Hydrological Cycle

This book presents recent results concerning the global existence in time, the large-time behavior, decays of solutions and the existence of global attractors for nonlinear parabolic-hyperbolic coupled systems of evolutionary partial differential equations.

Partial Differential Equations

There are many books on the use of numerical methods for solving engineering problems and for modeling of engineering artifacts. In addition there are many styles of such presentations ranging from books with a major emphasis on theory to books with an emphasis on applications. The purpose of this book is hopefully to present a somewhat different approach to the use of numerical methods for - gineering applications. Engineering models are in general nonlinear models where the response of some appropriate engineering variable depends in a nonlinear manner on the - plication of some independent parameter. It is certainly true that for many types of engineering models it is sufficient to approximate the real physical world by some linear model. However, when engineering environments are pushed to - treme conditions, nonlinear effects are always encountered. It is also such - treme conditions that are of major importance in determining the reliability or failure limits of engineering systems. Hence it is essential than engineers have a toolbox of modeling techniques that can be used to model nonlinear engineering systems. Such a set of basic numerical methods is the topic of this book. For each subject area treated, nonlinear models are incorporated into the discussion from the very beginning and linear models are simply treated as special cases of more general nonlinear models. This is a basic and fundamental difference in this book from most books on numerical methods.

Algorithms for the Solution of Systems of Coupled Second Order Ordinary Differential Equations

The Boussinesq equation is the first model of surface waves in shallow water that considers the nonlinearity and the dispersion and their interaction as a reason for wave stability known as the Boussinesq paradigm. This balance bears solitary waves that behave like quasi-particles. At present, there are some Boussinesq-like equations. The prevalent part of the known analytical and numerical solutions, however, relates to the 1d case while for multidimensional cases, almost nothing is known so far. An exclusion is the solutions of the Kadomtsev-Petviashvili equation. The difficulties originate from the lack of known analytic initial conditions and the nonintegrability in the multidimensional case. Another problem is which kind of nonlinearity will keep the temporal stability of localized solutions. The system of coupled nonlinear Schroedinger equations known as well as the vector Schroedinger equation is a soliton supporting dynamical system. It is considered as a model of light propagation in Kerr isotropic media. Along with that, the phenomenology of the equation opens a prospect of investigating the quasi-particle behavior of the interacting solitons. The initial polarization of the vector Schroedinger equation and its evolution evolves from the vector nature of the model. The existence of exact (analytical) solutions usually is rendered to simpler models, while for the vector Schroedinger equation such solutions are not known. This determines the role of the numerical schemes and approaches. The vector Schroedinger equation is a spring-board for combining the reduced integrability and conservation laws in a discrete level. The experimental observation and measurement of ultrashort pulses in waveguides is a hard job and this is the reason and stimulus to create mathematical models for computer simulations, as well as reliable algorithms for treating the governing equations. Along with the nonintegrability, one more problem appears here - the multidimensionality and necessity to split and linearize the operators in the appropriate way.

Nonlinear Systems of Partial Differential Equations

In this report a systematic mathematical method is introduced for the solution of problems involving two coupled modes in a coupled system with varying parameters. These problems involve systems of linear differential equations with varying coefficients. By the use of a linear transformation of the dependent variables and a double diagonalization process, the coupled mode equations are reduced to two decoupled Riccati equations. The final form of the general solution is obtained in terms of four varying coupling coefficients and a transform parameter. To illustrate some applications of the method, solutions of two special cases which have been solved previously by other workers are obtained. The solutions for a number of special cases, in which the varying coefficients are specified or interrelated, are also obtained. Further possible applications are indicated. (Author).

Solutions of Nonlinear Schrödinger Systems

This book considers an array of state-of-the-art coupling and modelling concepts. First the relevant Earth system cycles are presented, followed by a discussion on scale issues and multiple equilibria. Inter- and intra-compartmental coupling is addressed, along with a debate on non-linearities and questions of parameterisation. Several applications are presented, where a focus is on cases where the hydrological cycle plays a central role.

Pattern Formation in Continuous and Coupled Systems

This volume contains a number of mini-review articles authored by speakers and attendees at the IMA workshop on Pattern Formation in Continuous and Coupled Systems. Pattern formation has been studied intensively for most of this century by both experimentalists and theoreticians. This workshop focused on new directions in the patterns literature. The goals were to continue communication between these groups, and to familiarize a larger audience with some of the newer directions in the field. Systems that generate new types of pattern such as discrete coupled systems, systems with global coupling, and combustion experiments were stressed, as were new types of pattern. The mini-reviews in this volume are intended to be pointers to the current literature for researchers at all levels and therefore include extensive bibliographies. They are also intended to discuss why certain subjects are currently exciting and worthy of additional research.

Perturbation Methods for Engineers and Scientists

The Structure of the Cauchy Problem Solution for a Coupled System of Equations of Electrodynamics and Elasticity in the Case of Point Sources

Given the improved analytical capabilities of Excel, scientists and engineers everywhere are using it--instead of FORTRAN--to solve problems. And why not? Excel is installed on millions of computers, features a rich set of built-in analyses tools, and includes an integrated Visual Basic for Applications (VBA) programming language. No wonder it's today's computing tool of choice. Chances are you already use Excel to perform some fairly routine calculations. Now the Excel Scientific and Engineering Cookbook shows you how to leverage Excel to perform more complex calculations, too, calculations that once fell in the domain of specialized tools. It does so by putting a smorgasbord of data analysis techniques right at your fingertips. The book shows how to perform these useful tasks and others: Use Excel and VBA in general Import data from a variety of sources Analyze data Perform calculations Visualize the results for interpretation and presentation Use Excel to solve specific science and engineering problems Wherever possible, the Excel Scientific and Engineering Cookbook draws on real-world examples from a range of scientific disciplines such as biology, chemistry, and physics. This way, you'll be better prepared to solve the problems you face in your everyday scientific or engineering tasks. High on practicality and low on theory, this quick, look-up reference provides instant solutions, or "recipes," to problems both basic and advanced. And like other books in O'Reilly's popular Cookbook format, each recipe also includes a discussion on how and why it works. As a result, you can take comfort in knowing that complete, practical answers are a mere page-flip away.

Nonlinear Waves

This book is about the dynamics of coupled map lattices (CML) and of related spatially extended systems. It will be useful to post-graduate students and researchers seeking an overview of the state-of-the-art and of open problems in this area of nonlinear dynamics. The special feature of this book is that it describes the (mathematical) theory of CML and some related systems and their phenomenology, with some examples of CML modeling of concrete systems (from physics and biology). More precisely, the book deals with statistical properties of (weakly) coupled chaotic maps, geometric aspects of (chaotic) CML, monotonic spatially extended systems, and dynamical models of specific biological systems.

Nonlinear Parabolic-Hyperbolic Coupled Systems and Their Attractors

In the traditional curriculum, students rarely study nonlinear differential equations and nonlinear systems due to the difficulty or impossibility of computing explicit solutions manually. Although the theory associated with nonlinear systems is advanced, generating a numerical solution with a computer and interpreting that solution are fairly elementary. Bringing the computer into the classroom, Ordinary Differential Equations: Applications, Models, and Computing emphasizes the use of computer software in teaching differential equations. Providing an even balance between theory, computer solution, and application, the text discusses the theorems and applications of the first-order initial value problem, including learning theory models, population growth models, epidemic models, and chemical reactions. It then examines the theory for n-th order linear differential equations and the Laplace transform and its properties, before addressing several linear differential equations with constant coefficients that arise in physical and electrical systems. The author also presents systems of first-order differential equations as well as linear systems with constant coefficients that arise in physical systems, such as coupled spring-mass systems, pendulum systems, the path of an electron, and mixture problems. The final chapter introduces techniques for determining the behavior of solutions to systems of first-order differential equations without first finding the solutions. Designed to be independent of any particular software package, the book includes a CD-ROM with the software used to generate the solutions and graphs for the examples. The appendices contain complete instructions for running the software. A solutions manual is available for qualifying instructors.

Nonlinear Dynamics and Chaos

The coupling considered in this volume may be of physical or numerical nature. Examples of the first kind are the solid-fluid interactions, microelectronic systems, and the coupled modelling in groundwater flow. Examples of the latter kind are the domain or subspace decomposition, the local defect correction method, and the very important FEM-BEM coupling.

Synchronization in Coupled Chaotic

Circuits and Systems

Numerical Methods for Partial Differential Equations: Finite Difference and Finite Volume Methods focuses on two popular deterministic methods for solving partial differential equations (PDEs), namely finite difference and finite volume methods. The solution of PDEs can be very challenging, depending on the type of equation, the number of independent variables, the boundary, and initial conditions, and other factors. These two methods have been traditionally used to solve problems involving fluid flow. For practical reasons, the finite element method, used more often for solving problems in solid mechanics, and covered extensively in various other texts, has been excluded. The book is intended for beginning graduate students and early career professionals, although advanced undergraduate students may find it equally useful. The material is meant to serve as a prerequisite for students who might go on to take additional courses in computational mechanics, computational fluid dynamics, or computational electromagnetics. The notations, language, and technical jargon used in the book can be easily understood by scientists and engineers who may not have had graduate-level applied mathematics or computer science courses. Presents one of the few available resources that comprehensively describes and demonstrates the finite volume method for unstructured mesh used frequently by practicing code developers in industry Includes step-by-step algorithms and code snippets in each chapter that enables the reader to make the transition from equations on the page to working codes Includes 51 worked out examples that comprehensively demonstrate important mathematical steps, algorithms, and coding practices required to numerically solve PDEs, as well as how to interpret the results from both physical and mathematic perspectives

Nonlinear Parabolic Equations and Hyperbolic-Parabolic Coupled Systems

This monograph is devoted to the global existence, uniqueness and asymptotic behaviour of smooth solutions to both initial value problems and initial boundary value problems for nonlinear parabolic equations and hyperbolic parabolic coupled systems. Most of the material is based on recent research carried out by the author and his collaborators. The book can be divided into two parts. In the first part, the results on decay of solutions to nonlinear parabolic equations and hyperbolic parabolic coupled systems are obtained, and a chapter is devoted to the global existence of small smooth solutions to fully nonlinear parabolic equations and quasilinear hyperbolic parabolic coupled systems. Applications of the results to nonlinear thermoelasticity and fluid dynamics are also shown. Some nonlinear parabolic equations and coupled systems arising from the study of phase transitions are investigated in the second part of the book. The global existence, uniqueness and asymptotic behaviour of smooth solutions with arbitrary initial data are obtained. The final chapter is further devoted to related topics: multiplicity of equilibria and the existence of a global attractor, inertial manifold and inertial set. A knowledge of partial differential equations and Sobolev spaces is assumed. As an aid to the reader, the related concepts and results are collected and the relevant references given in the first chapter. The work will be of interest to researchers and graduate students in pure and applied mathematics, mathematical physics and applied sciences.

Ordinary Differential Equations

Enhanced by many worked examples, problems, and solutions, this in-depth text is suitable for undergraduates and presents a great deal of information previously only available in specialized and hard-to-find texts. 1981 edition.

Dynamics of Coupled Systems in High-Speed Railways

There has been a considerable progress made during the recent past on mathematical techniques for studying dynamical systems that arise in science and engineering. This progress has been, to a large extent, due to our increasing ability to mathematically model physical processes and to analyze and solve them, both analytically and numerically. With its eleven chapters, this book brings together important contributions from renowned international researchers to provide an excellent survey of recent advances in dynamical systems theory and applications. The first section consists of seven chapters that focus on analytical techniques, while the next section is composed of four chapters that center on computational techniques.

Dynamical Systems

Strongly Coupled Parabolic and Elliptic Systems

This book presents the latest numerical solutions to initial value problems and boundary value problems described by ODEs and PDEs. The author offers practical methods that can be adapted to solve wide ranges of problems and illustrates them in the increasingly popular open source computer language R, allowing integration with more statistically based methods. The book begins with standard techniques, followed by an overview of 'high resolution' flux limiters and WENO to solve problems with solutions exhibiting high gradient phenomena. Meshless methods using radial basis functions are then discussed in the context of scattered data interpolation and the solution of PDEs on irregular grids. Three detailed case studies demonstrate how numerical methods can be used to tackle very different complex problems. With its focus on practical solutions to real-world problems, this book will be useful to students and practitioners in all areas of science and engineering, especially those using R.

Mathematical Modelling with Case Studies

Mathematical Modelling with Case Studies: Using MapleTM and MATLAB®, Third Edition provides students with hands-on modelling skills for a wide variety of problems involving differential equations that describe rates of change. While the book focuses on growth and decay processes, interacting populations, and heating/cooling problems, the mathematical techniques presented can be applied to many other areas. The text carefully details the process of constructing a model, including the conversion of a seemingly complex problem into a much simpler one. It uses flow diagrams and word equations to aid in the model-building process and to develop the mathematical equations. Employing theoretical, graphical, and computational tools, the authors analyze the behavior of the models under changing conditions. The authors often examine a model numerically before solving it analytically. They also discuss the validation of the models and suggest extensions to the models with an emphasis on recognizing the strengths and limitations of each model. The highly recommended second edition was praised for its lucid writing style and numerous real-world examples. With updated MapleTM and MATLAB® code as well as new case studies and exercises, this third edition continues to give students a clear, practical understanding of the development and interpretation of mathematical models.

Numerical Solution of Ordinary Differential Equations

The subject of perturbation expansions is a powerful analytical technique which can be applied to problems which are too complex to have an exact solution, for example, calculating the drag of an aircraft in flight. These techniques can be used in place of complicated numerical solutions. This book provides an account of the main techniques of perturbation expansions applied to both differential equations and integral expressions. Features include a non-rigorous treatment of the subject at undergraduate level not available in any other current text; contains computer programs to enable the student to explore particular ideas and realistic case studies of industrial applications; a number of practical examples are included in the text to enhance understanding of points raised, particularly in the areas of mechanics and fluid mechanics; presents the main techniques of perturbation expansion at a level accessible to the undergraduate student.

Kronecker Products and Matrix Calculus with Applications

The authors study the unconstrained (free) motion of an elastic solid $\mathcal B$ in a Navier-Stokes liquid $\mathcal L$ occupying the whole space outside $\mathcal B$, under the assumption that a constant body force $\mathfrak b$ is acting on $\mathcal B$. More specifically, the authors are interested in the steady motion of the coupled system $\{\mathcal B,\mathcal L\}$, which means that there exists a frame with respect to which the relevant governing equations possess a time-independent solution. The authors prove the existence of such a frame, provided some smallness restrictions are imposed on the physical parameters, and the reference configuration of $\mathcal B$ satisfies suitable geometric properties.

Numerical Solution of the Coupled System of Nonlinear Fractional Ordinary Differential Equations

This textbook is aimed at newcomers to nonlinear dynamics and chaos, especially students taking a first course in the subject. The presentation stresses analytical methods, concrete examples, and geometric intuition. The theory is developed systematically, starting with first-order differential equations and their bifurcations, followed by phase plane analysis, limit cycles and their bifurcations, and culminating with the Lorenz equations, chaos, iterated maps, period doubling, renormalization, fractals, and strange attractors.

Computational Welding Mechanics

The 1st Conference on Physical Modeling for Virtual Manufacturing Systems and Processes is the result of the International Research Training Group (IRTG) 2057 "Physical Modeling for Virtual Manufacturing Systems and Processes", funded by the German Research Foundation (DFG). The IRTG began on 01 July 2014. Partner University of the University of Kaiserslautern, is the University of California, with its locations in Berkeley and Davis. At the conference the progress and the results of the first cohort of PhD students was presented. The conference was complemented by talks of international guest speakers from computer science and manufacturing engineering. The proceedings contain 22 peer-reviewed papers on Physical Modeling for Virtual Manufacturing Systems and Processes.

Symmetry Analysis of Differential Equations with Mathematica®

Numerical Data Fitting in Dynamical Systems

Control and Estimation of Distributed Parameter Systems

Numerical Methods for Nonlinear Engineering Models

Studies synchronization of coupled chaotic circuits and systems, as well as its applications.

Numerical Treatment of Coupled Systems

Strongly coupled (or cross-diffusion) systems of parabolic and elliptic partial differential equations appear in many physical applications. This book presents a new approach to the solvability of general strongly coupled systems, a much more difficult problem in contrast to the scalar case, by unifying, elucidating and extending breakthrough results obtained by the author, and providing solutions to many open fundamental questions in the theory. Several examples in mathematical biology and ecology are also included. Contents Interpolation Gagliardo–Nirenberg inequalities The parabolic systems The elliptic systems Cross-diffusion systems of porous media type Nontrivial steady-state solutions The duality RBMO(μ)–H1(μ)| Some algebraic inequalities Partial regularity

Asymptotic Behavior of Solutions of Model Problems for a Coupled System

On the Steady Motion of a Coupled System Solid-liquid

This is the second edition of the now definitive text on partial differential equations (PDE). It offers a comprehensive survey of modern techniques in the theoretical study of PDE with particular emphasis on nonlinear equations. Its wide scope and clear exposition make it a great text for a graduate course in PDE. For this edition, the author has made numerous changes, including a new chapter on nonlinear wave equations, more than 80 new exercises, several new sections, a significantly expanded bibliography. About the First Edition: I have used this book for both regular PDE and topics courses. It has a wonderful combination of insight and technical detail. Evans' book is evidence of his mastering of the field and the clarity of presentation. --Luis Caffarelli, University of Texas It is fun to teach from Evans' book. It explains many of the essential ideas and techniques of partial differential equations Every graduate student in analysis should read it. --David Jerison, MIT I use Partial Differential Equations to prepare my students for their Topic exam, which is a requirement before starting working on their dissertation. The book provides an excellent account of PDE's I am very happy with the preparation it provides my students. --Carlos Kenig, University of Chicago Evans' book has already attained the status of a classic. It is a clear choice for students just learning the subject, as well as for experts who wish to broaden their knowledge An outstanding reference for many aspects of the field. --Rafe Mazzeo, Stanford University

Optimal Control of Coupled Systems of Partial Differential Equations

Real life phenomena in engineering, natural, or medical sciences are often described by a mathematical model with the goal to analyze numerically the behaviour of the system. Advantages of mathematical models are their cheap availability, the possibility of studying extreme situations that cannot be handled by experiments, or of simulating real systems during the design phase before constructing a first prototype. Moreover, they serve to verify decisions, to avoid expensive and time consuming experimental tests, to analyze, understand, and explain the behaviour of systems, or to optimize design and production. As soon as a mathematical model contains differential dependencies from an additional parameter, typically the time, we call it a dynamical model. There are two key questions always arising in a practical environment: 1 Is the mathematical model correct? 2 How can I quantify model parameters that cannot be measured directly? In principle, both questions are easily answered as soon as some experimental data are available. The idea is to compare measured data with predicted model function values and to minimize the differences over the whole parameter space. We have to reject a model if we are unable to find a reasonably accurate fit. To summarize, parameter estimation or data fitting, respectively, is extremely important in all practical situations, where a mathematical model and corresponding experimental data are available to describe the behaviour of a dynamical system.

Numerical Analysis Using R

Introduces the theory and applications of the extended finite element method (XFEM) in the linear and nonlinear problems of continua, structures and geomechanics Explores the concept of partition of unity, various enrichment functions, and fundamentals of XFEM formulation. Covers numerous applications of XFEM including fracture mechanics, large deformation, plasticity, multiphase flow, hydraulic fracturing and contact problems Accompanied by a website hosting source code and examples

Computational Partial Differential Equations

The first book to explicitly use Mathematica so as to allow researchers and students to more easily compute and solve almost any kind of differential equation using Lie's theory. Previously time-consuming and cumbersome calculations are now much more easily and quickly performed using the Mathematica computer algebra software. The material in this book, and on the accompanying CD-ROM, will be of interest to a broad group of scientists, mathematicians and engineers involved in dealing with symmetry analysis of differential equations. Each section of the book starts with a theoretical discussion of the material, then shows the application in connection with Mathematica. The cross-platform CD-ROM contains Mathematica (version 3.0) notebooks which allow users to directly interact with the code presented within the book. In addition, the author's proprietary "MathLie" software is included, so users can readily learn to use this powerful tool in regard to performing algebraic computations.

Dynamics of Coupled Map Lattices and of Related Spatially Extended Systems

A concise introduction to numerical methodsand the mathematicalframework neededto understand their performance Numerical Solution of Ordinary Differential Equationspresents a complete and easy-tofollow introduction to classicaltopics in the numerical solution of ordinary differentialequations. The book's approach not only explains the presentedmathematics, but also helps readers understand how these numericalmethods are used to solve real-world problems. Unifying perspectives are provided throughout the text, bringingtogether and categorizing different types of problems in order tohelp readers comprehend the applications of ordinary differentialequations. In addition, the authors' collective academic experienceensures a coherent and accessible discussion of key topics,including: Euler's method Taylor and Runge-Kutta methods General error analysis for multi-step methods Stiff differential equations Differential algebraic equations Two-point boundary value problems Volterra integral equations Each chapter features problem sets that enable readers to testand build their knowledge of the presented methods, and a relatedWeb site features MATLAB® programs that facilitate theexploration of numerical methods in greater depth. Detailedreferences outline additional literature on both analytical andnumerical aspects of ordinary differential equations for furtherexploration of individual topics. Numerical Solution of Ordinary Differential Equations isan excellent textbook for courses on the numerical solution ofdifferential equations at the upper-undergraduate and beginninggraduate levels. It also serves as a valuable reference forresearchers in the fields of mathematics and engineering.

Numerical Methods for Partial

Differential Equations

Dynamics of Coupled Systems in High-Speed Railways: Theory and Practice presents the relationship between various coupled systems that can affect train operation, including interaction between track and train, the pantograph-catenary system and train, power supply system and train, and airflow and train, with respect to the structure and characteristics of high-speed railway. The overall simulation optimization and control are achieved based on an analysis of the dynamics generated by coupled systems in high-speed trains, with a theoretical framework for the dynamics presented in the book. Presents the first book available on the dynamics of coupled systems in high-speed trains Provides a systematic view of high-speed vehicle dynamics, covering the issues that are especially concerned for high speed operations, such as high-speed pantograph and catenary, aerodynamic characteristics and running stability of high-speed trains Covers the optimization of dynamic performance, the design of parameters, the simulation of high-speed train service processes, and the identification of high-speed train state and condition assessment