

Neural Algorithm For Solving Differential Equations

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Cyber-Physical Systems and Control II - Dmitry G. Arseniev 2023-02-21

The book contains selected research papers presented at the 2nd International Conference on Cyber-Physical Systems and Control (CPS&C'2021) which was held from 29 June to 2 July 2021 in St. Petersburg, Russia. The CPS&C'2021 Conference continues the series of international conferences that began in 2019 when the first International Conference on Cyber-Physical Systems and Control (CPS&C'2019) took place. Cyber-physical systems (CPSs) considered a modern and rapidly emerging generation of systems with integrated wide computational, information processing, and physical capabilities that can interact with humans through many new modalities and application areas of implementation. The book covers the latest advances, developments and achievements in new theories, algorithms, models, and applications of prospective problems associated with CPSs with an emphasis on control theory and related areas. The multidisciplinary fundamental scientific and engineering principles that underpin the integration of cyber and physical elements across all application areas are discussed in the book chapters. The materials of the book may be of interest to scientists and engineers working in the field of cyber-physical systems, systems analysis, control systems, computer technologies, and similar fields.

Computational Science and Its Applications – ICCSA 2021 - Osvaldo Gervasi 2021-09-10

The ten-volume set LNCS 12949 – 12958 constitutes the proceedings of the 21st International Conference on Computational Science and Its Applications, ICCSA 2021, which was held in Cagliari, Italy, during September 13 – 16, 2021. The event was organized in a hybrid mode due to the Covid-19 pandemic. The 466 full and 18 short papers presented in these proceedings were carefully reviewed and selected from 1588 submissions. The books cover such topics as multicore architectures, blockchain, mobile and wireless security, sensor networks, open source software, collaborative and social computing systems and tools, cryptography, applied mathematics human computer interaction, software design engineering, and others. Part IV of the set includes the papers on Urban and Regional Planning and the proceedings of the following workshops: International Workshop on Blockchain and Distributed Ledgers: Technologies and Applications (BDLTA 2021); International Workshop on Computational and Applied Mathematics (CAM 2021); International Workshop on Computational and Applied Statistics (CAS 2021); International Workshop on Computerized Evaluation of Economic Activities: Urban Spaces (CEEAA 2021). The chapters "Automated Housing Price Valuation and Spatial Data", "Spatial Automated Valuation Model (sAVM) – From the Notion of Space to the Design of an Evaluation Tool", and "A MCDA/GIS-Based Approach for Evaluating Accessibility to Health Facilities" are published open access under a CC BY license (Creative Commons Attribution 4.0 International License).

Optical Bistability: Controlling Light With Light - Hyatt Gibbs 2012-12-02

Optical Bistability: Controlling Light with Light focuses on optical bistability in nonlinear optical systems. Emphasis is on passive (non-laser) systems that exhibit reversible bistability with input intensity as the hysteresis variable, along with the physics and the potential applications of such systems for nonlinear optical signal processing. This book consists of seven chapters and begins with a historical overview of optical bistability in lasers and passive systems. The next chapter describes steady-state theories of optical bistability, including the Bonifacio-Lugiato model, as well as the boundary conditions of an optical cavity and the coupled Maxwell-Bloch equations. Both intrinsic and

hybrid experiments are then described, along with light-by-light control, pulse reshaping, and external switching. The transient phenomena that arise either from instabilities in the bistable systems themselves or from fluctuations in the number of nonlinear atoms or in the number of intracavity photons are also considered. The final chapter examines the characteristics and fundamental limitations of an ideal device, the prospect of improving devices by identifying giant nonlinearities, and the utilization of the full power of optics by parallel processing. This monograph is intended for new entrants and active workers in the field of optical bistability.

High Performance Computing - Heike Jagode 2020-10-19

This book constitutes the refereed post-conference proceedings of 10 workshops held at the 35th International ISC High Performance 2020 Conference, in Frankfurt, Germany, in June 2020: First Workshop on Compiler-assisted Correctness Checking and Performance Optimization for HPC (C3PO); First International Workshop on the Application of Machine Learning Techniques to Computational Fluid Dynamics Simulations and Analysis (CFDML); HPC I/O in the Data Center Workshop (HPC-IODC); First Workshop "Machine Learning on HPC Systems" (MLHPCS); First International Workshop on Monitoring and Data Analytics (MODA); 15th Workshop on Virtualization in High-Performance Cloud Computing (VHPC). The 25 full papers included in this volume were carefully reviewed and selected. They cover all aspects of research, development, and application of large-scale, high performance experimental and commercial systems. Topics include high-performance computing (HPC), computer architecture and hardware, programming models, system software, performance analysis and modeling, compiler analysis and optimization techniques, software sustainability, scientific applications, deep learning.

Convergent Cognitive Information Technologies - Vladimir Sukhomlin 2020-01-31

This book constitutes the refereed proceedings of the Third International Conference on Convergent Cognitive Information Technologies, Convergent 2018, held in Moscow, Russia, in December 2018. The 26 revised full papers and 9 short papers were carefully reviewed and selected from 147 submissions. The papers of this volume are organized in topical sections on theoretical questions of computer science, computational mathematics, computer science and cognitive information technologies; cognitive information technologies in control systems; big data and applications; the Internet of Things (IoT): standards, communication and information technologies, network applications; smart cities: standards, cognitive-information technologies and their applications.- cognitive information technologies in the digital economics.- digital transformation of transport. Computational Science - ICCS 2001 - Vassil N. Alexandrov 2003-05-15 LNCS volumes 2073 and 2074 contain the proceedings of the International Conference on Computational Science, ICCS 2001, held in San Francisco, California, May 27-31, 2001. The two volumes consist of more than 230 contributed and invited papers that reflect the aims of the conference to bring together researchers and scientists from mathematics and computer science as basic computing disciplines, researchers from various application areas who are pioneering advanced application of computational methods to sciences such as physics, chemistry, life sciences, and engineering, arts and humanitarian fields, along with software developers and vendors, to discuss problems and solutions in the area, to identify new issues, and to shape future directions for research, as well as to help industrial users apply various advanced

computational techniques.

Backward Stochastic Differential Equations - N El Karoui 1997-01-17

This book presents the texts of seminars presented during the years 1995 and 1996 at the Université Paris VI and is the first attempt to present a survey on this subject. Starting from the classical conditions for existence and unicity of a solution in the most simple case-which requires more than basic stochastic calculus-several refinements on the hypotheses are introduced to obtain more general results.

Applications in Engineering, Life and Social Sciences - Dumitru Băleanu 2019-04-01

This multi-volume handbook is the most up-to-date and comprehensive reference work in the field of fractional calculus and its numerous applications. This seventh volume collects authoritative chapters covering several applications of fractional calculus in in engineering, life, and social sciences, including applications in biology and medicine, mechanics of complex media, economy, and electrical devices.

Design Feed Forward Neural Networks for Solving Ordinary Initial Value - Yassen Adel 2013

The aim of this book is to design fast feed forward neural networks to present a method to solve initial value problem for ordinary differential equations. That is to develop an algorithm which can speedup the solution times, reduce solver failures, and increase possibility of obtaining the globally optimal solution. The applicability of this approach ranges from single ordinary differential equations, to systems of ordinary differential equations with initial condition. Also, a variety of compute the search direction k of conjugate gradient training algorithm are introduced and we describing several different training algorithms, many modified and new algorithms have been proposed for training Feed Forward Neural Network(FFNN), many of them having a very fast convergence rate for reasonable size networks. In all of these algorithms we use the gradient of the performance function(energy function) to determine how to adjust the weights such that the performance function is minimized, where the back propagation algorithm has been used to increase the speed of training. Finally, we illustrate the method by solving a variety of model problems."

Differential Equations and Their Applications - M. Braun 2013-06-29

For the past several years the Division of Applied Mathematics at Brown University has been teaching an extremely popular sophomore level differential equations course. The immense success of this course is due primarily to two factors. First, and foremost, the material is presented in a manner which is rigorous enough for our mathematics and applied mathematics majors, but yet intuitive and practical enough for our engineering, biology, economics, physics and geology majors. Secondly, numerous case histories are given of how researchers have used differential equations to solve real life problems. This book is the outgrowth of this course. It is a rigorous treatment of differential equations and their applications, and can be understood by anyone who has had a two semester course in Calculus. It contains all the material usually covered in a one or two semester course in differential equations. In addition, it possesses the following unique features which distinguish it from other textbooks on differential equations.

ECAI 2020 - G. De Giacomo 2020-09-11

This book presents the proceedings of the 24th European Conference on Artificial Intelligence (ECAI 2020), held in Santiago de Compostela, Spain, from 29 August to 8 September 2020. The conference was postponed from June, and much of it conducted online due to the COVID-19 restrictions. The conference is one of the principal occasions for researchers and practitioners of AI to meet and discuss the latest trends and challenges in all fields of AI and to demonstrate innovative applications and uses of advanced AI technology. The book also includes the proceedings of the 10th Conference on Prestigious Applications of Artificial Intelligence (PAIS 2020) held at the same time. A record number of more than 1,700 submissions was received for ECAI 2020, of which 1,443 were reviewed. Of these, 361 full-papers and 36 highlight papers were accepted (an acceptance rate of 25% for full-papers and 45% for highlight papers). The book is divided into three sections: ECAI full papers; ECAI highlight papers; and PAIS papers. The topics of these papers cover all aspects

of AI, including Agent-based and Multi-agent Systems; Computational Intelligence; Constraints and Satisfiability; Games and Virtual Environments; Heuristic Search; Human Aspects in AI; Information Retrieval and Filtering; Knowledge Representation and Reasoning; Machine Learning; Multidisciplinary Topics and Applications; Natural Language Processing; Planning and Scheduling; Robotics; Safe, Explainable, and Trustworthy AI; Semantic Technologies; Uncertainty in AI; and Vision. The book will be of interest to all those whose work involves the use of AI technology.

Knowledge Guided Machine Learning - Anuj Karpatne 2022-08-15

Given their tremendous success in commercial applications, machine learning (ML) models are increasingly being considered as alternatives to science-based models in many disciplines. Yet, these "black-box" ML models have found limited success due to their inability to work well in the presence of limited training data and generalize to unseen scenarios. As a result, there is a growing interest in the scientific community on creating a new generation of methods that integrate scientific knowledge in ML frameworks. This emerging field, called scientific knowledge-guided ML (KGML), seeks a distinct departure from existing "data-only" or "scientific knowledge-only" methods to use knowledge and data at an equal footing. Indeed, KGML involves diverse scientific and ML communities, where researchers and practitioners from various backgrounds and application domains are continually adding richness to the problem formulations and research methods in this emerging field. Knowledge Guided Machine Learning: Accelerating Discovery using Scientific Knowledge and Data provides an introduction to this rapidly growing field by discussing some of the common themes of research in KGML using illustrative examples, case studies, and reviews from diverse application domains and research communities as book chapters by leading researchers. KEY FEATURES First-of-its-kind book in an emerging area of research that is gaining widespread attention in the scientific and data science fields Accessible to a broad audience in data science and scientific and engineering fields Provides a coherent organizational structure to the problem formulations and research methods in the emerging field of KGML using illustrative examples from diverse application domains Contains chapters by leading researchers, which illustrate the cutting-edge research trends, opportunities, and challenges in KGML research from multiple perspectives Enables cross-pollination of KGML problem formulations and research methods across disciplines Highlights critical gaps that require further investigation by the broader community of researchers and practitioners to realize the full potential of KGML

Intelligent Information and Database Systems - Manh Thanh Le 2010-07-26

The 2010 Asian Conference on Intelligent Information and Database Systems (ACIIDS) was the second event of the series of international scientific conferences for research and applications in the field of intelligent information and database systems. The aim of ACIIDS 2010 was to provide an international forum for scientific research in the technologies and applications of intelligent information, database systems and their applications. ACIIDS 2010 was co-organized by Hue University (Vietnam) and Wroclaw University of Technology (Poland) and took place in Hue city (Vietnam) during March 24–26, 2010. We received almost 330 papers from 35 countries. Each paper was peer reviewed by at least two members of the International Program Committee and International Reviewer Board. Only 96 best papers were selected for oral presentation and publication in the two volumes of the ACIIDS 2010 proceedings. The papers included in the proceedings cover the following topics: artificial social systems, case studies and reports on deployments, collaborative learning, collaborative systems and applications, data warehousing and data mining, database management technologies, database models and query languages, database security and integrity,- business, e-commerce, e-finance, e-learning systems, information modeling and - requirements engineering, information retrieval systems, intelligent agents and multi-agent systems, intelligent information systems, intelligent internet systems, intelligent optimization techniques, object-relational DBMS, ontologies and information sharing, semi-structured and XML database systems, unified modeling language and unified processes, Web services and Semantic Web, computer networks and communication systems.

Solving Differential Equations With Deep Neural Networks (DNNs). - Jaysa Grafton 2022

Overall, the goal of this project is to make use of the machine learning algorithm of deep neural networks (DNNs) to solve differential equations. Specifically, this project aims to solve two different second-order differential equations: Poisson and Ginzburg-Landau equations. Results for the Poisson equation show an accurate solution can be acquired using a single layer network with no activation function due to the linearity of the equation. These results demonstrate that finding solutions to differential equations is possible through the use of deep neural networks. For the Ginzburg-Landau equation, two different loss functions are utilized with adjustments being made to account for boundary conditions and derivatives. Results indicate an accurate approximation for various mesh sizes (i.e., coarse versus fine mesh) and allow for the comparison of network architectures for each mesh size in order to determine the parameters necessary for an accurate solution.

Fractional Differential Equations - Anatoly Kochubei 2019-02-19

This multi-volume handbook is the most up-to-date and comprehensive reference work in the field of fractional calculus and its numerous applications. This second volume collects authoritative chapters covering the mathematical theory of fractional calculus, including ordinary and partial differential equations of fractional order, inverse problems, and evolution equations.

Mathematics for Machine Learning - Marc Peter Deisenroth 2020-04-23

The fundamental mathematical tools needed to understand machine learning include linear algebra, analytic geometry, matrix decompositions, vector calculus, optimization, probability and statistics. These topics are traditionally taught in disparate courses, making it hard for data science or computer science students, or professionals, to efficiently learn the mathematics. This self-contained textbook bridges the gap between mathematical and machine learning texts, introducing the mathematical concepts with a minimum of prerequisites. It uses these concepts to derive four central machine learning methods: linear regression, principal component analysis, Gaussian mixture models and support vector machines. For students and others with a mathematical background, these derivations provide a starting point to machine learning texts. For those learning the mathematics for the first time, the methods help build intuition and practical experience with applying mathematical concepts. Every chapter includes worked examples and exercises to test understanding. Programming tutorials are offered on the book's web site.

Contact Problems in Elasticity - N. Kikuchi 1988-01-01

The contact of one deformable body with another lies at the heart of almost every mechanical structure. Here, in a comprehensive treatment, two of the field's leading researchers present a systematic approach to contact problems. Using variational formulations, Kikuchi and Oden derive a multitude of new results, both for classical problems and for nonlinear problems involving large deflections and buckling of thin plates with unilateral supports, dry friction with nonclassical laws, large elastic and elastoplastic deformations with frictional contact, dynamic contacts with dynamic frictional effects, and rolling contacts. This method exposes properties of solutions obscured by classical methods, and it provides a basis for the development of powerful numerical schemes. Among the novel results presented here are algorithms for contact problems with nonlinear and nonlocal friction, and very effective algorithms for solving problems involving the large elastic deformation of hyperelastic bodies with general contact conditions. Includes detailed discussion of numerical methods for nonlinear materials with unilateral contact and friction, with examples of metalforming simulations. Also presents algorithms for the finite deformation rolling contact problem, along with a discussion of numerical examples.

Artificial Neural Networks - ICANN 2007 - Joaquim Marques de Sá 2007-09-14

This book is the second of a two-volume set that constitutes the refereed proceedings of the 17th International Conference on Artificial Neural Networks, ICANN 2007. It features contributions related to computational neuroscience, neurocognitive studies, applications in biomedicine and

bioinformatics, pattern recognition, self-organization, text mining and internet applications, signal and times series processing, vision and image processing, robotics, control, and more.

Semi-empirical Neural Network Modeling and Digital Twins Development - Dmitriy Tarkhov 2019-11-23

Semi-empirical Neural Network Modeling presents a new approach on how to quickly construct an accurate, multilayered neural network solution of differential equations. Current neural network methods have significant disadvantages, including a lengthy learning process and single-layered neural networks built on the finite element method (FEM). The strength of the new method presented in this book is the automatic inclusion of task parameters in the final solution formula, which eliminates the need for repeated problem-solving. This is especially important for constructing individual models with unique features. The book illustrates key concepts through a large number of specific problems, both hypothetical models and practical interest. Offers a new approach to neural networks using a unified simulation model at all stages of design and operation Illustrates this new approach with numerous concrete examples throughout the book Presents the methodology in separate and clearly-defined stages

Fast Feed Forward Neural Networks to Solve Boundary Value Problems - Muna Ali 2012

The aim of this book is to design fast feed forward neural networks to present a method to solve two point boundary value problems for ordinary differential equations, that is, design a fully connected networks contains links between all nodes in adjacent layers which can speedup the solution times, reduce solver failures, and increase possibility of obtaining the globally optimal solution. We training suggested network by Levenberg - Marquardt, BFGS Quasi-Newton, Bayesian regularization, CG training algorithm with Polak-Ribiere update procedure then speeding suggested networks by modification these training algorithm, many of them having a very fast convergence rate for reasonable size networks. The above modify algorithms have a variety of different computation and storage requirements, however non of the above algorithms has a global properties, such as stability and convergence, which suited to all problems, and all the above algorithms applied in solving two point boundary value problem . Finally, we illustrate the suggested network by solving a variety of model problems and present comparisons with solutions obtained using other different method .

Recent Trends in Wave Mechanics and Vibrations - S. Chakraverty 2019-11-12

This book consists of select proceedings of the National Conference on Wave Mechanics and Vibrations (WMVC 2018). It covers recent developments and cutting-edge methods in wave mechanics and vibrations applied to a wide range of engineering problems. The book presents analytical and computational studies in structural mechanics, seismology and earthquake engineering, mechanical engineering, aeronautics, robotics and nuclear engineering among others. This book can be useful for students, researchers, and professionals interested in the wide-ranging applications of wave mechanics and vibrations.

Mathematical Treatment of Nanomaterials and Neural Networks - Jia-Bao Liu 2021-12-03

Artificial Neural Networks for Engineers and Scientists - S. Chakraverty 2017-07-20

Differential equations play a vital role in the fields of engineering and science. Problems in engineering and science can be modeled using ordinary or partial differential equations. Analytical solutions of differential equations may not be obtained easily, so numerical methods have been developed to handle them. Machine intelligence methods, such as Artificial Neural Networks (ANN), are being used to solve differential equations, and these methods are presented in Artificial Neural Networks for Engineers and Scientists: Solving Ordinary Differential Equations. This book shows how computation of differential equation becomes faster once the ANN model is properly developed and applied.

Advances in Artificial Systems for Logistics Engineering - Zhengbing Hu

2022-04-28

The book comprises high-quality refereed research papers presented at the Second International Conference on Artificial Intelligence and Logistics Engineering (ICAILE2022), held in Kyiv, Ukraine, on February 20–22, 2022, organized jointly by the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute," Wuhan University of Technology, Nanning University, National Aviation University, and the International Research Association of Modern Education and Computer Science. The topics discussed in the book include state-of-the-art papers in artificial intelligence and logistics engineering. It is an excellent source of references for researchers, graduate students, engineers, management practitioners, and undergraduate students interested in artificial intelligence and its applications in logistics engineering.

Deep Learning in Computational Mechanics - Stefan Kollmannsberger
2021-08-05

This book provides a first course on deep learning in computational mechanics. The book starts with a short introduction to machine learning's fundamental concepts before neural networks are explained thoroughly. It then provides an overview of current topics in physics and engineering, setting the stage for the book's main topics: physics-informed neural networks and the deep energy method. The idea of the book is to provide the basic concepts in a mathematically sound manner and yet to stay as simple as possible. To achieve this goal, mostly one-dimensional examples are investigated, such as approximating functions by neural networks or the simulation of the temperature's evolution in a one-dimensional bar. Each chapter contains examples and exercises which are either solved analytically or in PyTorch, an open-source machine learning framework for python.

Solving Differential Equations in R - Karline Soetaert 2012-06-06

Mathematics plays an important role in many scientific and engineering disciplines. This book deals with the numerical solution of differential equations, a very important branch of mathematics. Our aim is to give a practical and theoretical account of how to solve a large variety of differential equations, comprising ordinary differential equations, initial value problems and boundary value problems, differential algebraic equations, partial differential equations and delay differential equations. The solution of differential equations using R is the main focus of this book. It is therefore intended for the practitioner, the student and the scientist, who wants to know how to use R for solving differential equations. However, it has been our goal that non-mathematicians should at least understand the basics of the methods, while obtaining entrance into the relevant literature that provides more mathematical background. Therefore, each chapter that deals with R examples is preceded by a chapter where the theory behind the numerical methods being used is introduced. In the sections that deal with the use of R for solving differential equations, we have taken examples from a variety of disciplines, including biology, chemistry, physics, pharmacokinetics. Many examples are well-known test examples, used frequently in the field of numerical analysis.

Advances in Mathematical Modelling, Applied Analysis and Computation - Jagdev Singh 2022-10-13

This book is a valuable source for graduate students and researchers and provides a comprehensive introduction to recent theories and applications of mathematical modeling and numerical simulation. It includes selected peer-reviewed papers presented at the 4th International Conference on Mathematical Modelling, Applied Analysis and Computation (ICMMAAC 2021), held at JECRC University, Jaipur, India, during August 5–7, 2021. The book is focused on mathematical modeling of various problems arising in science and engineering and new efficient numerical approaches for solving linear nonlinear problems and rigorous mathematical theories, which can be used to analyze different kinds of mathematical models. Applications of mathematical methods in physics, chemistry, biology, mechanical engineering, civil engineering, computer science, social science, and finance are presented.

Applied Stochastic Differential Equations - Simo Särkkä 2019-05-02

With this hands-on introduction readers will learn what SDEs are all about

and how they should use them in practice.

Intelligent Systems Modeling and Simulation II - Samsul Ariffin Abdul Karim
2022-10-12

This book develops a new system of modeling and simulations based on intelligence system. As we are directly moving from Third Industrial Revolution (IR3.0) to Fourth Industrial Revolution (IR4.0), there are many emergence techniques and algorithm that appear in many sciences and engineering branches. Nowadays, most industries are using IR4.0 in their product development as well as to refine their products. These include simulation on oil rig drilling, big data analytics on consumer analytics, fastest algorithm for large-scale numerical simulations and many more. These will save millions of dollar in the operating costs. Without any doubt, mathematics, statistics and computing are well blended to form an intelligent system for simulation and modeling. Motivated by this rapid development, in this book, a total of 41 chapters are contributed by the respective experts. The main scope of the book is to develop a new system of modeling and simulations based on machine learning, neural networks, efficient numerical algorithm and statistical methods. This book is highly suitable for postgraduate students, researchers as well as scientists that have interest in intelligent numerical modeling and simulations.

Augmented Lagrangian and Operator Splitting Methods in Nonlinear Mechanics - Roland Glowinski 1989-01-01

This volume deals with the numerical simulation of the behavior of continuous media by augmented Lagrangian and operator-splitting methods.

Applied Artificial Neural Network Methods For Engineers And Scientists: Solving Algebraic Equations - Snehashish Chakraverty 2021-01-26

The aim of this book is to handle different application problems of science and engineering using expert Artificial Neural Network (ANN). As such, the book starts with basics of ANN along with different mathematical preliminaries with respect to algebraic equations. Then it addresses ANN based methods for solving different algebraic equations viz. polynomial equations, diophantine equations, transcendental equations, system of linear and nonlinear equations, eigenvalue problems etc. which are the basic equations to handle the application problems mentioned in the content of the book. Although there exist various methods to handle these problems, but sometimes those may be problem dependent and may fail to give a converge solution with particular discretization. Accordingly, ANN based methods have been addressed here to solve these problems. Detail ANN architecture with step by step procedure and algorithm have been included. Different example problems are solved with respect to various application and mathematical problems. Convergence plots and/or convergence tables of the solutions are depicted to show the efficacy of these methods. It is worth mentioning that various application problems viz. Bakery problem, Power electronics applications, Pole placement, Electrical Network Analysis, Structural engineering problem etc. have been solved using the ANN based methods.

An Introduction to Neural Network Methods for Differential Equations - Neha Yadav 2015-02-26

This book introduces a variety of neural network methods for solving differential equations arising in science and engineering. The emphasis is placed on a deep understanding of the neural network techniques, which has been presented in a mostly heuristic and intuitive manner. This approach will enable the reader to understand the working, efficiency and shortcomings of each neural network technique for solving differential equations. The objective of this book is to provide the reader with a sound understanding of the foundations of neural networks and a comprehensive introduction to neural network methods for solving differential equations together with recent developments in the techniques and their applications. The book comprises four major sections. Section I consists of a brief overview of differential equations and the relevant physical problems arising in science and engineering. Section II illustrates the history of neural networks starting from their beginnings in the 1940s through to the renewed interest of the 1980s. A general introduction to neural networks and learning technologies is presented in Section III. This section also includes the description of the multilayer perceptron and its learning methods. In Section IV, the different

neural network methods for solving differential equations are introduced, including discussion of the most recent developments in the field. Advanced students and researchers in mathematics, computer science and various disciplines in science and engineering will find this book a valuable reference source.

Fractional Calculus - Praveen Agarwal 2019-11-23

This book collects papers presented at the International Conference on Fractional Differentiation and its Applications (ICFDA), held at the University of Jordan, Amman, Jordan, on 16–18 July 2018. Organized into 13 chapters, the book discusses the latest trends in various fields of theoretical and applied fractional calculus. Besides an essential mathematical interest, its overall goal is a general improvement of the physical world models for the purpose of computer simulation, analysis, design and control in practical applications. It showcases the development of fractional calculus as an acceptable tool for a large number of diverse scientific communities due to more adequate modeling in various fields of mechanics, electricity, chemistry, biology, medicine, economics, control theory, as well as signal and image processing. The book will be a valuable resource for graduate students and researchers of mathematics and engineering.

Mathematical Methods in Interdisciplinary Sciences - Snehashish Chakraverty 2020-06-15

Brings mathematics to bear on your real-world, scientific problems

Mathematical Methods in Interdisciplinary Sciences provides a practical and usable framework for bringing a mathematical approach to modelling real-life scientific and technological problems. The collection of chapters Dr. Snehashish Chakraverty has provided describe in detail how to bring mathematics, statistics, and computational methods to the fore to solve even the most stubborn problems involving the intersection of multiple fields of study. Graduate students, postgraduate students, researchers, and professors will all benefit significantly from the author's clear approach to applied mathematics. The book covers a wide range of interdisciplinary topics in which mathematics can be brought to bear on challenging problems requiring creative solutions. Subjects include: Structural static and vibration problems Heat conduction and diffusion problems Fluid dynamics problems The book also covers topics as diverse as soft computing and machine intelligence. It concludes with examinations of various fields of application, like infectious diseases, autonomous car and monotone inclusion problems.

Scientific and Technical Aerospace Reports - 1992

Spectral Methods - Jie Shen 2011-08-25

Along with finite differences and finite elements, spectral methods are one of the three main methodologies for solving partial differential equations on computers. This book provides a detailed presentation of basic spectral algorithms, as well as a systematic presentation of basic convergence theory and error analysis for spectral methods. Readers of this book will be exposed to a unified framework for designing and analyzing spectral algorithms for a variety of problems, including in particular high-order differential equations and problems in unbounded domains. The book contains a large number of figures which are designed to illustrate various concepts stressed in the book. A set of basic matlab codes has been made available online to help the readers to develop their own spectral codes for their specific applications.

Fractional Calculus and Fractional Differential Equations - Varsha Daftardar-Gejji 2019-08-10

This book provides a broad overview of the latest developments in fractional calculus and fractional differential equations (FDEs) with an aim to motivate the readers to venture into these areas. It also presents original research describing the fractional operators of variable order, fractional-order delay differential equations, chaos and related phenomena in detail. Selected results on the stability of solutions of nonlinear dynamical systems of the non-commensurate fractional order have also been included. Furthermore, artificial neural network and fractional differential equations are elaborated on; and new transform methods (for example, Sumudu methods) and how they can be employed to solve fractional partial differential equations are discussed. The book covers the latest research on a variety of topics, including:

comparison of various numerical methods for solving FDEs, the Adomian decomposition method and its applications to fractional versions of the classical Poisson processes, variable-order fractional operators, fractional variational principles, fractional delay differential equations, fractional-order dynamical systems and stability analysis, inequalities and comparison theorems in FDEs, artificial neural network approximation for fractional operators, and new transform methods for solving partial FDEs. Given its scope and level of detail, the book will be an invaluable asset for researchers working in these areas.

Artificial Neural Networks for Engineers and Scientists - S. Chakraverty 2017-07-20

Differential equations play a vital role in the fields of engineering and science. Problems in engineering and science can be modeled using ordinary or partial differential equations. Analytical solutions of differential equations may not be obtained easily, so numerical methods have been developed to handle them. Machine intelligence methods, such as Artificial Neural Networks (ANN), are being used to solve differential equations, and these methods are presented in *Artificial Neural Networks for Engineers and Scientists: Solving Ordinary Differential Equations*. This book shows how computation of differential equation becomes faster once the ANN model is properly developed and applied.

Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number - Wen Yu 2019-07-10

An original, systematic-solution approach to uncertain nonlinear systems control and modeling using fuzzy equations and fuzzy differential equations There are various numerical and analytical approaches to the modeling and control of uncertain nonlinear systems. Fuzzy logic theory is an increasingly popular method used to solve inconvenience problems in nonlinear modeling. *Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number* presents a structured approach to the control and modeling of uncertain nonlinear systems in industry using fuzzy equations and fuzzy differential equations. The first major work to explore methods based on neural networks and Bernstein neural networks, this innovative volume provides a framework for control and modeling of uncertain nonlinear systems with applications to industry. Readers learn how to use fuzzy techniques to solve scientific and engineering problems and understand intelligent control design and applications. The text assembles the results of four years of research on control of uncertain nonlinear systems with dual fuzzy equations, fuzzy modeling for uncertain nonlinear systems with fuzzy equations, the numerical solution of fuzzy equations with Z-numbers, and the numerical solution of fuzzy differential equations with Z-numbers. Using clear and accessible language to explain concepts and principles applicable to real-world scenarios, this book: Presents the modeling and control of uncertain nonlinear systems with fuzzy equations and fuzzy differential equations Includes an overview of uncertain nonlinear systems for non-specialists Teaches readers to use simulation, modeling and verification skills valuable for scientific research and engineering systems development Reinforces comprehension with illustrations, tables, examples, and simulations *Modeling and Control of Uncertain Nonlinear Systems with Fuzzy Equations and Z-Number* is suitable as a textbook for advanced students, academic and industrial researchers, and practitioners in fields of systems engineering, learning control systems, neural networks, computational intelligence, and fuzzy logic control.

Advances in Computational Intelligence Systems - Ahmad Lotfi 2018-08-10

This book presents the latest trends in and approaches to computational intelligence research and its application to intelligent systems. It covers a long list of interconnected research areas, such as fuzzy systems, neural networks, evolutionary computation, clustering and classification, machine learning, data mining, cognition and robotics, and deep learning. The individual chapters are based on peer-reviewed contributions presented at the 18th Annual UK Workshop on Computational Intelligence (UKCI-2018), held in Nottingham, UK on September 5-7, 2018. The book puts a special emphasis on novel methods and reports on their use in a wide range of applications areas, thus providing both academics and professionals with a comprehensive and timely overview of new trends in computational intelligence.

