

Fuzzy Mathematics Approximation Theory

This book constitutes the refereed proceedings of the First International Conference on Soft Computing and Data Mining, SCDM 2014, held in Universiti Tun Hussein Onn Malaysia, in June 16th-18th, 2014. The 65 revised full papers presented in this book were carefully reviewed and selected from 145 submissions, and organized into two main topical sections; Data Mining and Soft Computing. The goal of this book is to provide both theoretical concepts and, especially, practical techniques on these exciting fields of soft computing and data mining, ready to be applied in real-world applications. The exchanges of views pertaining future research directions to be taken in this field and the resultant dissemination of the latest research findings makes this work of immense value to all those having an interest in the topics covered.

Knowledge can be modeled and computed using computational mathematical methods, then lead to real world conclusions. The strongly related to that Computational Analysis is a very large area with lots of applications. This monograph includes a great variety of topics of Computational Analysis. We present: probabilistic wavelet approximations, constrained abstract approximation theory, shape preserving weighted approximation, non positive approximations to definite integrals, discrete best approximation, approximation theory of general Picard singular operators including global smoothness preservation property, fractional singular operators. We also deal with non-isotropic general Picard singular multivariate operators and q-Gauss-Weierstrass singular q-integral operators. We talk about quantitative approximations by shift-invariant univariate and multivariate integral operators, nonlinear neural networks approximation, convergence with rates of positive linear operators, quantitative approximation by bounded linear operators, univariate and multivariate quantitative approximation by stochastic positive linear operators on univariate and multivariate stochastic processes. We further present right fractional calculus and give quantitative fractional Korovkin theory of positive linear operators. We also give analytical inequalities, fractional Opial inequalities, fractional identities and inequalities regarding fractional integrals. We further deal with semi group operator approximation, simultaneous Feller probabilistic approximation. We also present Fuzzy singular operator approximations. We give transfers from real to fuzzy approximation and talk about fuzzy wavelet and fuzzy neural networks approximations, fuzzy fractional calculus and fuzzy Ostrowski inequality. We talk about discrete fractional calculus, nabla discrete fractional calculus and inequalities. We study the q-inequalities, and q-fractional inequalities. We further study time scales: delta and nabla approaches, duality principle and inequalities. We introduce delta and nabla time scales fractional calculus and inequalities. We finally study convergence with rates of approximate solutions to exact solution of multivariate Dirichlet problem and multivariate heat equation, and discuss the uniqueness of solution of general evolution partial differential equation \ in multivariate time. The exposed results are expected to find applications to: applied and computational

mathematics, stochastics, engineering, artificial intelligence, vision, complexity and machine learning. This monograph is suitable for graduate students and researchers.

Advances in Applied Mathematics and Approximation Theory: Contributions from AMAT 2012 is a collection of the best articles presented at “Applied Mathematics and Approximation Theory 2012,” an international conference held in Ankara, Turkey, May 17-20, 2012. This volume brings together key work from authors in the field covering topics such as ODEs, PDEs, difference equations, applied analysis, computational analysis, signal theory, positive operators, statistical approximation, fuzzy approximation, fractional analysis, semigroups, inequalities, special functions and summability. The collection will be a useful resource for researchers in applied mathematics, engineering and statistics.

Fuzzy Mathematics: Approximation Theory Springer

35 Years of Fuzzy Set Theory

Fuzzy Networks for Complex Systems

Contributions from AMAT 2012

Proceedings of The First International Conference on Soft Computing and Data Mining (SCDM-2014)

Universiti Tun Hussein Onn Malaysia, Johor, Malaysia June 16th-18th, 2014

Approximation by Max-Product Type Operators

New Advancements and Applications

This book is a tribute to Etienne E. Kerre on the occasion of his retirement on October 1st, 2010, after being active for 35 years in the field of fuzzy set theory. It gathers contributions from researchers that have been close to him in one way or another during his long and fruitful career. Besides a foreword by Lotfi A. Zadeh, it contains 13 chapters on both theoretical and applied topics in fuzzy set theory, divided in three parts: 1) logics and connectives, 2) data analysis, and 3) media applications. The first part deals with fuzzy logics and with operators on (extensions of) fuzzy sets. Part 2 deals with fuzzy methods in rough set theory, formal concept analysis, decision making and classification. The last part discusses the use of fuzzy methods for representing and manipulating media objects, such as images and text documents. The diversity of the topics that are covered reflect the diversity of Etienne's research interests, and indeed, the diversity of current research in the area of fuzzy set theory.

This volume contains contributions from international experts in the fields of constructive approximation. This area has reached out to encompass the computational and approximation-theoretical aspects of various interesting fields in applied mathematics.

This book focuses on computational and fractional analysis, two areas that are very important in their own right, and which are used in a broad variety of real-world applications. We start with the important Iyengar type inequalities and we continue with Choquet integral analytical inequalities, which are involved in major applications in economics. In turn, we address the local fractional derivatives of Riemann–Liouville type and related results including inequalities. We examine the case of low order Riemann–Liouville fractional derivatives and inequalities without initial conditions, together with related approximations. In the next section, we discuss quantitative

complex approximation theory by operators and various important complex fractional inequalities. We also cover the conformable fractional approximation of Csiszar's well-known f -divergence, and present conformable fractional self-adjoint operator inequalities. We continue by investigating new local fractional M -derivatives that share all the basic properties of ordinary derivatives. In closing, we discuss the new complex multivariate Taylor formula with integral remainder. Sharing results that can be applied in various areas of pure and applied mathematics, the book offers a valuable resource for researchers and graduate students, and can be used to support seminars in related fields.

The book, titled "Linguistic Fuzzy-Logic Methods in Social Sciences," is a first in its kind. Linguistic fuzzy logic theory deals with sets or categories whose boundaries are blurry or, in other words, "fuzzy," and which are expressed in a formalism that uses "words" to compute, not numbers, termed in engineering as "soft computing." This book presents an accessible introduction to this linguistic fuzzy logic methodology, focusing on its applicability to social sciences. Specifically, this is the first book to propose an approach based on linguistic fuzzy-logic and the method of computing with words to the analysis of decision making processes, strategic interactions, causality, and data analysis in social sciences. The project consists of systematic, theoretical and practical discussions and developments of these new methods as well as their applications to various substantive issues of interest to international relations scholars, political scientists, and social scientists in general.

Information Processing and Management of Uncertainty in Knowledge-Based Systems

Linguistic Fuzzy Logic Methods in Social Sciences

Fuzzy Systems To Quantum Mechanics

Sequence Spaces

Intelligent Analysis: Fractional Inequalities and Approximations Expanded

Advances in Computational Intelligence, Part III

This unique compendium represents important action of fuzzy systems to quantum mechanics. From fuzzy sets to fuzzy systems, it also gives clear descriptions on the development on fuzzy logic, where the most important result is the probability presentation of fuzzy systems. The important conclusions on fuzzy systems are used in the study of quantum mechanics, which is a very new idea. Eight important conclusions are obtained. The author has proved that mass-point motions in classical mechanics must have waves, which means that any mass-point motion in classical mechanics has wave mass-point dualism as well as any microscopic particle motion must have wave-particle dualism. Based on this conclusion, it has been proven that classical mechanics and quantum mechanics are unified. This book constitutes the proceedings of the Third International Conference on Mathematics and Computing, ICMC 2017, held in Haldia, India, in January 2017. The 35 papers presented in this volume were carefully reviewed and selected from 129 submissions. They were organized in topical sections named: security and privacy; computing; applied mathematics; and pure mathematics.

Decision makers usually face multiple, conflicting objectives and the complicated fuzzy-like environments in the real world. What are the fuzzy-like environments? How do we model the multiple objective decision making problems under fuzzy-like environments? How do you deal with these models? In order to answer these questions, this book provides an up-to-date methodology system for fuzzy-like multiple objective decision making, which includes modelling system, model analysis system, algorithm system and application system in

structure optimization problem, selection problem, purchasing problem, inventory problem, logistics problem and so on. Researchers, practitioners and students in management science, operations research, information science, system science and engineering science will find this work a useful reference.

This book introduces the novel concept of a fuzzy network whose nodes are rule bases and the connections between the nodes are the interactions between the rule bases in the form of outputs fed as inputs. The concept is presented as a systematic study for improving the feasibility and transparency of fuzzy models by means of modular rule bases whereby the model accuracy and efficiency can be optimised in a flexible way. The study uses an effective approach for fuzzy rule based modelling of complex systems that are characterised by attributes such as nonlinearity, uncertainty, dimensionality and structure. The approach is illustrated by formal models for fuzzy networks, basic and advanced operations on network nodes, properties of operations, feedforward and feedback fuzzy networks as well as evaluation of fuzzy networks. The results are demonstrated by numerous examples, two case studies and software programmes within the Matlab environment that implement some of the theoretical methods from the book. The book shows the novel concept of a fuzzy network with networked rule bases as a bridge between the existing concepts of a standard fuzzy system with a single rule base and a hierarchical fuzzy system with multiple rule bases.

Unification of Fractional Calculi with Applications

Evolving Fuzzy Systems - Methodologies, Advanced Concepts and Applications

Topics in Modern Summability Theory

14th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, IPMU 2012, Catania, Italy, July 9 - 13, 2012. Proceedings, Part III

A Modular Rule Base Approach

Introduces a method of research which can be used in various fields of mathematics. This monograph is the first in Fuzzy Approximation Theory. It contains mostly the author's research work on fuzziness of the last ten years and relies a lot on [10]-[32] and it is a natural outgrowth of them. It belongs to the broader area of Fuzzy Mathematics. Chapters are self-contained and several advanced courses can be taught out of this book. We provide lots of applications but always within the framework of Fuzzy Mathematics. In each chapter is given background and motivations. A complete list of references is provided at the end. The topics covered are very diverse. In Chapter 1 we give an extensive basic background on Fuzziness and Fuzzy Real Analysis, as well a complete description of the book. In the following Chapters 2,3 we cover in deep Fuzzy Differentiation and Integration Theory, e.g. we present Fuzzy Taylor Formulae. It follows Chapter 4 on Fuzzy Ostrowski Inequalities. Then in Chapters 5, 6 we present results on

classical algebraic and trigonometric polynomial Fuzzy Approximation.

This book is aimed at both experts and non-experts with an interest in getting acquainted with sequence spaces, matrix transformations and their applications. It consists of several new results which are part of the recent research on these topics. It provides different points of view in one volume, e.g. their topological properties, geometry and summability, fuzzy valued study and more. This book presents the important role sequences and series play in everyday life, it covers geometry of Banach Sequence Spaces, it discusses the importance of generalized limit, it offers spectrum and fine spectrum of several linear operators and includes fuzzy valued sequences which exhibits the study of sequence spaces in fuzzy settings. This book is the main attraction for those who work in Sequence Spaces, Summability Theory and would also serve as a good source of reference for those involved with any topic of Real or Functional Analysis.

This book presents a mathematically-based introduction into the fascinating topic of Fuzzy Sets and Fuzzy Logic and might be used as textbook at both undergraduate and graduate levels and also as reference guide for mathematician, scientists or engineers who would like to get an insight into Fuzzy Logic. Fuzzy Sets have been introduced by Lotfi Zadeh in 1965 and since then, they have been used in many applications. As a consequence, there is a vast literature on the practical applications of fuzzy sets, while theory has a more modest coverage. The main purpose of the present book is to reduce this gap by providing a theoretical introduction into Fuzzy Sets based on Mathematical Analysis and Approximation Theory. Well-known applications, as for example fuzzy control, are also discussed in this book and placed on new ground, a theoretical foundation. Moreover, a few advanced chapters and several new results are included. These comprise, among others, a new systematic and constructive approach for fuzzy inference systems of Mamdani and Takagi-Sugeno types, that investigates their approximation capability by providing new error estimates.

Computation and Applied Mathematics

Progress in Intelligent Decision Science

Generalized Fractional Calculus

**Trends and Applications in Constructive Approximation
Advanced Computing in Industrial Mathematics
Fuzzy Operator Theory in Mathematical Analysis**

This monograph presents a broad treatment of developments in an area of constructive approximation involving the so-called "max-product" type operators. The exposition highlights the max-product operators as those which allow one to obtain, in many cases, more valuable estimates than those obtained by classical approaches. The text considers a wide variety of operators which are studied for a number of interesting problems such as quantitative estimates, convergence, saturation results, localization, to name several. Additionally, the book discusses the perfect analogies between the probabilistic approaches of the classical Bernstein type operators and of the classical convolution operators (non-periodic and periodic cases), and the possibilistic approaches of the max-product variants of these operators. These approaches allow for two natural interpretations of the max-product Bernstein type operators and convolution type operators: firstly, as possibilistic expectations of some fuzzy variables, and secondly, as bases for the Feller type scheme in terms of the possibilistic integral. These approaches also offer new proofs for the uniform convergence based on a Chebyshev type inequality in the theory of possibility. Researchers in the fields of approximation of functions, signal theory, approximation of fuzzy numbers, image processing, and numerical analysis will find this book most beneficial. This book is also a good reference for graduates and postgraduates taking courses in approximation theory.

This monograph presents the author's work of the last five years in approximation theory. The chapters are self-contained and can be read independently. Readers will find the topics covered are diverse and advanced courses can be taught out of this book. The first part of the book is dedicated to fractional monotone approximation theory introduced for the first time by the author, taking the related ordinary theory of usual differentiation at the fractional differentiation level with polynomials and splines as approximators. The second part deals with the approximation by discrete singular operators of the Favard style, for example, of the Picard and Gauss-Weierstrass types. Then, it continues in a very detailed and extensive chapter on approximation by interpolating operators induced by neural networks, a connection to computer science. This book ends with the approximation theory and functional analysis on time scales, a very modern topic, detailing all the pros and cons of this method. The results in this

book are expected to find applications in many areas of pure and applied mathematics. So far, very little is written about fractional approximation theory which is at its infancy. As such, it is suitable for researchers, graduate students, and performing seminars as well as an invaluable resource for all science libraries. Contents: Fractional Monotone Approximation Right Fractional Monotone Approximation Theory Univariate Left Fractional Polynomial High Order Monotone Approximation Theory Univariate Right Fractional Polynomial High Order Monotone Approximation Theory Spline Left Fractional Monotone Approximation Theory Using Left Fractional Differential Operators Spline Right Fractional Monotone Approximation Theory Using Right Fractional Differential Operators Complete Fractional Monotone Approximation Theory Lower Order Fractional Monotone Approximation Theory Approximation Theory by Discrete Singular Operators On Discrete Approximation by Gauss-Weierstrass and Picard Type Operators Approximation Theory by Interpolating Neural Networks Approximation and Functional Analysis Over Time Scales Readership: Graduate students and researchers in approximation theory. Key Features: Presents new research in approximation theory An extensive list of references is given in every chapter It is about fractional approximation, neural networks and singular integrals approximations Important to applications in applied mathematics Keywords: Fractional Approximation; Neural Networks; Singular Integrals This monograph belongs to the broader area of Fuzzy Mathematics and it is the first one in Fuzzy Approximation Theory. The chapters are self-contained with lots of applications to teach several advanced courses and the topics covered are very diverse. An extensive background of Fuzziness and Fuzzy Real Analysis is given. The author covers Fuzzy Differentiation and Integration Theory followed by Fuzzy Ostrowski inequalities. Then results on classical algebraic and trigonometric polynomial Fuzzy Approximation are presented. The author develops a complete theory of convergence with rates of Fuzzy Positive linear operators to Fuzzy unit operator, the so-called Fuzzy Korovkin Theory. The related Fuzzy Global Smoothness is included. Then follows the study of Fuzzy Wavelet type operators and their convergence with rates to Fuzzy unit operator. Similarly the Fuzzy Neural Network Operators are discussed followed by Fuzzy Random Korovkin approximation theory and Fuzzy Random Neural Network approximations. The author continues with Fuzzy Korovkin approximations in the sense of Summability. Finally fuzzy sense differences of Fuzzy Wavelet type operators are estimated. The monograph's approach is quantitative and the main results are given via Fuzzy inequalities, involving Fuzzy moduli of

continuity, that is Fuzzy Jackson type inequalities. The exposed theory is destined and expected to find applications to all aspects of Fuzziness from theoretical to practical in almost all sciences, technology, finance and industry. Also it has its interest within Pure Mathematics. So this monograph is suitable for researchers, graduate students and seminars of theoretical and applied mathematics, computer science, statistics and engineering.

Provides readers with the foundations of fuzzy mathematics as well as more advanced topics A Modern Introduction to Fuzzy Mathematics provides a concise presentation of fuzzy mathematics., moving from proofs of important results to more advanced topics, like fuzzy algebras, fuzzy graph theory, and fuzzy topologies. The authors take the reader through the development of the field of fuzzy mathematics, starting with the publication in 1965 of Lotfi Asker Zadeh's seminal paper, Fuzzy Sets. The book begins with the basics of fuzzy mathematics before moving on to more complex topics, including: Fuzzy sets Fuzzy numbers Fuzzy relations Possibility theory Fuzzy abstract algebra And more Perfect for advanced undergraduate students, graduate students, and researchers with an interest in the field of fuzzy mathematics, A Modern Introduction to Fuzzy Mathematics walks through both foundational concepts and cutting-edge, new mathematics in the field.

Third International Conference, ICMC 2017, Haldia, India, January 17-21, 2017, Proceedings

Frontiers in Approximation Theory

Recent Advances on Soft Computing and Data Mining

Stability Analysis of Fuzzy-Model-Based Control Systems

Fuzzy Optimization

16th International Conference, IPMU 2016, Eindhoven, The Netherlands, June 20 - 24, 2016,

Proceedings, Part II

This self-contained monograph presents an overview of fuzzy operator theory in mathematical analysis. Concepts, principles, methods, techniques, and applications of fuzzy operator theory are unified in this book to provide an introduction to graduate students and researchers in mathematics, applied sciences, physics, engineering, optimization, and operations research. New approaches to fuzzy operator theory and fixed point theory with applications to fuzzy metric spaces, fuzzy normed spaces, partially ordered fuzzy metric spaces, fuzzy normed algebras, and non-Archimedean fuzzy metric spaces are presented. Surveys are provided on: Basic theory of fuzzy metric and normed spaces and its topology, fuzzy normed and Banach spaces, linear operators, fundamental theorems (open

mapping and closed graph), applications of contractions and fixed point theory, approximation theory and best proximity theory, fuzzy metric type space, topology and applications.

This volume presents the state of the art of new developments, and some interesting and relevant applications of the OWA (ordered weighted averaging) operators. The OWA operators were introduced in the early 1980s by Ronald R. Yager as a conceptually and numerically simple, easily implementable, yet extremely powerful general aggregation operator. That simplicity, generality and implementability of the OWA operators, combined with their intuitive appeal, have triggered much research both in the foundations and extensions of the OWA operators, and in their applications to a wide variety of problems in various fields of science and technology. Part I: Methods includes papers on theoretical foundations of OWA operators and their extensions. The papers in Part II: Applications show some more relevant applications of the OWA operators, mostly means, as powerful yet general aggregation operators. The application areas are exemplified by environmental modeling, social networks, image analysis, financial decision making and water resource management.

This special volume is a collection of outstanding more applied articles presented in AMAT 2015 held in Ankara, May 28-31, 2015, at TOBB Economics and Technology University. The collection is suitable for Applied and Computational Mathematics and Engineering practitioners, also for related graduate students and researchers. Furthermore it will be a useful resource for all science and engineering libraries. This book includes 29 self-contained and well-edited chapters that can be among others useful for seminars in applied and computational mathematics, as well as in engineering. Production engineering and management involve a series of planning and control activities in a production system. A production system can be as small as a shop with only one machine or as big as a global operation including many manufacturing plants, distribution centers, and retail locations in multiple continents. The product of a production system can also vary in complexity based on the material used, technology employed, etc. Every product, whether a pencil or an airplane, is produced in a system which depends on good management to be successful. Production management has been at the center of industrial engineering and management science disciplines since the industrial revolution. The tools and techniques of production management have been so successful that they have been adopted to various service industries, as well. The book is intended to be a valuable resource to undergraduate and graduate students interested in the applications of production management under fuzziness. The chapters represent all areas of production management and are organized to reflect the natural order of production management tasks. In all chapters, special attention is given to applicability and wherever possible, numerical examples are presented. While the reader is expected to have a fairly good understanding of the fuzzy logic, the book provides the necessary notation and preliminary knowledge needed in each chapter.

Mathematics of Fuzzy Sets and Fuzzy Logic

Production Engineering and Management under Fuzziness
Defects of Properties in Mathematics
Advances in Applied Mathematics and Approximation Theory
Celebratory Volume Dedicated to the Retirement of Etienne E. Kerre
Handbook of Analytic Computational Methods in Applied Mathematics

This monograph is the continuation and completion of the monograph, "Intelligent Systems: Approximation by Artificial Neural Networks" written by the same author and published 2011 by Springer. The book you hold in hand presents the complete recent and original work of the author in approximation by neural networks. Chapters are written in a self-contained style and can be read independently. Advanced courses and seminars can be taught out of this brief book. Necessary background and motivations are given per chapter. A related list of references is given also per chapter. The book's results are expected to find applications in many areas of applied mathematics, computer science and engineering. Such as this monograph is suitable for researchers, graduate students, and seminars of the above subjects, also for all mathematics and engineering libraries.

In this book, the state-of-the-art fuzzy-model-based (FMB) based control approaches are covered. A comprehensive analysis about the stability analysis of type-1 and type-2 FMB control systems using the Lyapunov-based approach is given, presenting a clear picture to researchers who would like to work on this field. A wide variety of continuous-time nonlinear control systems such as state-feedback, switching, time-delay and sampled-data FMB control systems, are covered. In this book, the authors summarize the recent contributions of the authors on the stability analysis of the FMB control systems. The book provides advanced stability analysis techniques for various FMB control systems, and finds a concrete theoretical basis to the investigation of FMB control systems at the research level. The analysis results of this book offer various mathematical approaches to designing stable and well-performed FMB control systems. Furthermore, the results widen the application of the FMB control approach and help put the fuzzy controller in practice. A wide range of advanced analytical and mathematical analysis techniques will be employed to investigate the system stability and performance of FMB-based control systems in a rigorous manner. Detailed analysis and derivation steps are given to enhance the readability, enabling the readers who are unfamiliar with the FMB control systems to follow the materials easily. Simulation examples, with figures and plots of system responses, are given to demonstrate the effectiveness of the proposed FMB control approaches. This book gathers original research papers presented at the 4th International Conference on Computational Mathematics and Engineering Sciences, held at Akdeniz University, Antalya, Turkey, on 20–22 April 2019. Focusing on computational methods in science, mathematical tools applied to engineering, mathematical modeling and new aspects of analysis,

discusses the applications of mathematical modelling in areas such as health science, engineering, computer science, science, and economics. It also describes a wide variety of analytical, computational, and numerical methods. The book is aimed to foster cooperation between students and researchers in the areas of computational mathematics and engineering sciences, and provide a platform for them to share significant research ideas. This book is a valuable resource for graduate students, researchers and educators interested in the mathematical tools and techniques required for solving various problems arising in science and engineering, and understanding new methods and uses of mathematical analysis. As the title of the book suggests, the topics of this book are organized into two parts. The first part points out the differential equations and the second one is related to the fuzzy integral equations. The book contains nine chapters. The first two chapters are about fuzzy differential equations and three of them are about fuzzy integral equations. In each part, the chapters' authors are going to discuss the topics theoretically and numerically. All researchers and students in the fields of mathematical, computer, and also engineering sciences can benefit from the subjects of the book.

Quantitative Characterizations

Recent Developments in the Ordered Weighted Averaging Operators: Theory and Practice

Fuzzy-Like Multiple Objective Decision Making

Intelligent Mathematics: Computational Analysis

Linear-Matrix-Inequality Approach

Recent Advances and Applications

This book contains the topics of artificial intelligence and deep learning that do have much application in real-life problems. The concept of uncertainty has long been used in applied science, especially decision making and a logical decision must be made in the field of uncertainty or in the real-life environment that is formed and combined with vague concepts and data. The chapters of this book are connected to the new concepts and aspects of decision making with uncertainty. Besides, other chapters are involved with the concept of data mining and decision making under uncertain computations.

This potent area of technology allows us to formulate and solve a multitude of problems. Written by leading experts, this overview covers a number of aspects of fuzzy optimization, some related general issues, and various applications of this powerful tool.

In today's real-world applications, there is an increasing demand of integrating new information and knowledge on-demand into model building processes to account for changing system dynamics, new operating conditions, varying human behaviors or environmental influences. Evolving fuzzy systems (EFS) are a powerful tool to cope with this requirement, as they are able to automatically adapt parameters, expand their structure and extend

their memory on-the-fly, allowing on-line/real-time modeling. This book comprises several evolving fuzzy systems approaches which have emerged during the last decade and highlights the most important incremental learning methods used. The second part is dedicated to advanced concepts for increasing performance, robustness, process-safety and reliability, for enhancing user-friendliness and enlarging the field of applicability of EFS and for improving the interpretability and understandability of the evolved models. The third part underlines the usefulness and necessity of evolving fuzzy systems in several online real-world application scenarios, provides an outline of potential future applications and raises open problems and new challenges for the next generation evolving systems, including human-inspired evolving machines. The book includes basic principles, concepts, algorithms and theoretic results underlined by illustrations. It is dedicated to researchers from the field of fuzzy systems, machine learning, data mining and system identification as well as engineers and technicians who apply data-driven modeling techniques in real-world systems.

Working computationally in applied mathematics is the very essence of dealing with real-world problems in science and engineering. Approximation theory-on the borderline between pure and applied mathematics- has always supplied some of the most innovative ideas, computational methods, and original approaches to many types of problems. The f

Towards Intelligent Modeling: Statistical Approximation Theory

Intelligent Systems II: Complete Approximation by Neural Network Operators

Advances in Fuzzy Integral and Differential Equations

4th International Conference on Computational Mathematics and Engineering Sciences (CMES-2019)

11th Annual Meeting of the Bulgarian Section of SIAM December 20-22, 2016, Sofia, Bulgaria. Revised Selected Papers

Mathematics and Computing

These four volumes (CCIS 297, 298, 299, 300) constitute the proceedings of the 14th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems, IPMU 2012, held in Catania, Italy, in July 2012. The 258 revised full papers presented together with six invited talks were carefully reviewed and selected from numerous submissions. The papers are organized in topical sections on fuzzy machine learning and on-line modeling; computing with words and decision making; soft computing in computer vision; rough sets and complex data analysis: theory and applications; intelligent databases and information system; information fusion systems; philosophical and methodological aspects of soft computing; basic issues in rough sets; 40th anniversary of the measures of fuzziness; SPS11 uncertainty in profiling systems and applications; handling uncertainty with copulas; formal methods to deal with uncertainty of many-valued events; linguistic summarization and description of data; fuzzy implications: theory and applications; sensing and data mining for teaching and learning; theory and applications of intuitionistic fuzzy sets; approximate aspects of data mining and database analytics; fuzzy numbers and their applications; information processing and management of uncertainty in knowledge-based systems; aggregation functions; imprecise probabilities; probabilistic graphical models with imprecision: theory and applications; belief function theory: basics and/or

applications; fuzzy uncertainty in economics and business; new trends in De Finetti's approach; fuzzy measures and integrals; multicriteria decision making; uncertainty in privacy and security; uncertainty in the spirit of Pietro Benvenuti; cooperation; game theory; probabilistic approach.

This two volume set (CCIS 610 and 611) constitute the proceedings of the 16th International Conference on Information processing and Management of Uncertainty in Knowledge-Based Systems, IPMU 2016, held in Eindhoven, The Netherlands, in June 2016. The 127 revised full papers presented together with four invited talks were carefully reviewed and selected from numerous submissions. The papers are organized in topical sections on fuzzy measures and integrals; uncertainty quantification with imprecise probability; textual data processing; belief functions theory and its applications; graphical models; fuzzy implications functions; applications in medicine and bioinformatics; real-world applications; soft computing for image processing; clustering; fuzzy logic, formal concept analysis and rough sets; graded and many-valued modal logics; imperfect databases; multiple criteria decision methods; argumentation and belief revision; databases and information systems; conceptual aspects of data aggregation and complex data fusion; fuzzy sets and fuzzy logic; decision support; comparison measures; machine learning; social data processing; temporal data processing; aggregation.

The main idea of statistical convergence is to demand convergence only for a majority of elements of a sequence. This method of convergence has been investigated in many fundamental areas of mathematics such as: measure theory, approximation theory, fuzzy logic theory, summability theory, and so on. In this monograph we consider this concept in approximating a function by linear operators, especially when the classical limit fails. The results of this book not only cover the classical and statistical approximation theory, but also are applied in the fuzzy logic via the fuzzy-valued operators. The authors in particular treat the important Korovkin approximation theory of positive linear operators in statistical and fuzzy sense. They also present various statistical approximation theorems for some specific real and complex-valued linear operators that are not positive. This is the first monograph in Statistical Approximation Theory and Fuzziness. The chapters are self-contained and several advanced courses can be taught. The research findings will be useful in various applications including applied and computational mathematics, stochastics, engineering, artificial intelligence, vision and machine learning. This monograph is directed to graduate students, researchers, practitioners and professors of all disciplines.

This book applies generalized fractional differentiation techniques of Caputo, Canavati and Conformable types to a great variety of integral inequalities e.g. of Ostrowski and Opial types, etc. Some of these are extended to Banach space valued functions. These inequalities have also great impact in numerical analysis, stochastics and fractional differential equations. The book continues with generalized fractional approximations by positive sublinear operators which derive from the presented Korovkin type inequalities and also includes abstract cases. It presents also multivariate complex Korovkin quantitative approximation theory. It follows M-fractional integral inequalities of Ostrowski and Polya types. The results are weighted so they provide a great variety of cases and applications. The second part of the book deals with the quantitative fractional Korovkin type approximation of stochastic processes and lays there the foundations of stochastic fractional calculus. The book considers both Caputo and Conformable fractional directions and derives regular and trigonometric results. The positive linear operators can be expectation operator commutative or not. This book results are expected to find applications in many areas of pure and applied mathematics and stochastics. As such this monograph is suitable for researchers, graduate students, and seminars of the above disciplines, also to be in all science and engineering libraries.

Approximation Theory and Approximation Practice, Extended Edition

Intelligent Mathematics II: Applied Mathematics and Approximation Theory

A Modern Introduction to Fuzzy Mathematics

Proceeding of IDS 2020

Fuzzy Mathematics: Approximation Theory

This book presents recent research on Advanced Computing in Industrial Mathematics, which is one of the most prominent interdisciplinary areas, bringing together mathematics, computer science, scientific computations, engineering, physics, chemistry, medicine, etc. Further, the book presents the major tools used in Industrial Mathematics, which are based on mathematical models, and the corresponding computer codes, which are used to perform virtual experiments to obtain new data or to better understand previous experimental findings. The book gathers the peer-reviewed papers presented at the 11th Annual Meeting of the Bulgarian Section of SIAM (BGSIAM), from December 20 to 22, 2016 in Sofia, Bulgaria.

This is a textbook on classical polynomial and rational approximation theory for the twenty-first century. Aimed at advanced undergraduates and graduate students across all of applied mathematics, it uses MATLAB to teach the field's most important ideas and results. Approximation Theory and Approximation Practice, Extended Edition differs fundamentally from other works on approximation theory in a number of ways: its emphasis is on topics close to numerical algorithms; concepts are illustrated with Chebfun; and each chapter is a PUBLISHable MATLAB M-file, available online. The book centers on theorems and methods for analytic functions, which appear so often in applications, rather than on functions at the edge of discontinuity with their seductive theoretical challenges. Original sources are cited rather than textbooks, and each item in the bibliography is accompanied by an editorial comment. In addition, each chapter has a collection of exercises, which span a wide range from mathematical theory to Chebfun-based numerical experimentation. This textbook is appropriate for advanced undergraduate or graduate students who have an understanding of numerical analysis and complex analysis. It is also appropriate for seasoned mathematicians who use MATLAB.