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Discrete Fractional Calculus - Piotr Ostalczyk 2015-11-26 The main subject of the monograph is the fractional calculus in the discrete version. The volume is divided into three main parts. Part one contains a theoretical introduction to the classical and fractional-order discrete calculus where the fundamental role is played by the backward difference and sum. In the second part, selected applications of the discrete fractional calculus in the discrete system control theory are presented. In the discrete system identification, analysis and synthesis, one can consider integer or fractional models based on the fractional-order difference equations. The third part of the book is devoted to digital image processing.

Discrete Fractional Calculus - Christopher Goodrich 2016-02-09 This text provides the first comprehensive treatment of the discrete fractional calculus. Experienced researchers will find the text useful as a reference for discrete fractional calculus and topics of current interest. Students who are interested in learning about discrete fractional calculus will find this text to provide a useful starting point. Several exercises are offered at the end of each chapter and select answers have been provided at the end of the book.

The presentation of the content is designed to give ample flexibility for potential use in a myriad of courses and for independent study. The novel approach taken by the authors includes a simultaneous treatment of the fractional- and integer-order difference calculus (on a variety of time scales, including both the usual forward and backwards difference operators). The reader will acquire a solid foundation in the classical topics of the discrete calculus while being introduced to exciting recent developments, bringing them to the frontiers of the student. Most chapters may be covered or omitted, depending upon the background of the student. For example, the text may be used as a primary reference in an introductory course for difference equations which also includes discrete fractional calculus.

Chapters 1–2 provide a basic introduction to the delta calculus including fractional calculus on the set of integers. For courses where students already have background in elementary real analysis, Chapters 1–2 may be covered quickly and readers may then skip to Chapters 6–7 which present some basic results in fractional boundary value problems (FBVPs). Chapters 6–7 in conjunction with some of the current literature listed in the bibliography can provide a basis for a seminar in the current theory of FBVPs. For a two-semester course, Chapters 1–5 may be covered in depth, providing a very thorough introduction to both the discrete fractional calculus as well as the integer-order calculus.

The Theory of Discrete Fractional Calculus - Michael T. Holm 2011

New Trends in Nanotechnology and Fractional Calculus Applications - Dumitru Baleanu 2010-03-14 In recent years fractional calculus has played an important role in various fields such as mechanics, electricity, chemistry, biology, economics, modeling, identification, control theory and signal processing. The scope of this book is to present the state of the art in the study of fractional systems and the application of fractional differentiation. Furthermore, the manufacture of nanowires is important for the design of nanosensors and the development of high-yield thin films is vital in procuring clean solar energy. This wide range of applications is of interest to engineers, physicists and mathematicians.

Discrete Fractional Calculus - Piotr Ostalczyk 2015-11-26 The main subject of the monograph is the fractional calculus in the discrete version. The volume is divided into three main parts. Part one contains a theoretical introduction to the classical and fractional-order discrete calculus where the fundamental role is played by the backward difference and sum. In the second part, selected applications of the discrete fractional calculus in the discrete system control theory are presented. In the discrete system identification, analysis and synthesis, one can consider integer or fractional models based on the fractional-order difference equations. The third part of the book is devoted to digital image processing.

Discrete Fractional Calculus and Its Applications to Tumor Growth - Sevgi Sengul 2010

Non-Integer Order Calculus and its Applications - Piotr Ostalczyk 2018-03-22 This book focuses on fractional calculus, presenting novel advances in both the theory and applications of non-integer order systems. At the end of the twentieth century it was predicted that it would be the calculus of the twenty-first century, and that prophecy is confirmed year after year. Now this mathematical tool is successfully used in a variety of research areas, like engineering (e.g. electrical, mechanical, chemical), dynamical systems modeling, analysis and synthesis (e.g. technical, biological, economical) as well as in multidisciplinary areas (e.g. biochemistry, electrochemistry). As well as the mathematical foundations the book concentrates on the technical applications of continuous-time and discrete-time fractional calculus, investigating the identification, analysis and control of electrical circuits and dynamical systems. It also presents the latest results. Although some scientific centers and scientists are skeptical and actively criticize the applicability of fractional calculus, it is worth breaking through the scientific and technological walls. Because the "fractional community" is growing rapidly there is a pressing need for the exchange of scientific results. The book includes papers presented at the 9th International Conference on Non-integer Order Calculus and its Applications and is divided into three parts: mathematical foundations: fractional systems analysis and synthesis: System modelingSeven papers discuss the mathematical foundations, twelve papers address fractional order analysis and synthesis and three focus on dynamical system modeling by the fractional order differential and difference equations. It is a useful resource for fractional calculus scientific community.

Fractional Signals and Systems - Manuel Duarte Ortigueira 2020-03-09 The book illustrates the theoretical results of fractional derivatives via applications in signals and systems, covering continuous and discrete derivatives, and the corresponding linear systems. Both time and frequency analysis are presented. Some advanced topics are included like derivatives of stochastic processes. It is an essential reference for researchers in mathematics, physics, and engineering.

Advances in Non-Integer Order Calculus and Its Applications - Agnieszka B. Malinowska 2019-04-17 This book provides an overview of some recent findings in the theory and applications of non-integer order systems. Discussing topics ranging from the mathematical foundations to technical applications of continuous-time and discrete-time fractional calculus, it includes 22 original research papers and is subdivided into four parts: Mathematical Foundations Approximation, Modeling and Simulations Fractional Systems Analysis and Control Applications The papers were selected from those presented at the 10th International
Fractional Calculus and Its Applications - B. Ross 2006-11-15

Applications of Fractional Calculus in Physics - R Hilfer 2000-03-02

Fractional calculus is a collection of relatively little-known mathematical results concerning generalizations of differentiation and integration to noninteger orders. While these results have been accumulated over centuries in various branches of mathematics, they have until recently found little appreciation or application in physics and other mathematically oriented sciences. This situation is beginning to change, and there are now a growing number of research areas in physics which employ fractional calculus. This volume provides an introduction to fractional calculus for physicists, and collects easily accessible review articles surveying those areas of physics in which applications of fractional calculus have recently become prominent. Contents: An Introduction to Fractional Calculus (P L Butzer & U Westphal) Fractional Time Evolution (R Hilfer) Fractional Powers of Infinite-dimensional Generators of Semigroups (U Westphal) Fractional Differences, Derivatives and Fractal Time Series (B J West & P Grigolini) Fractional Kinetics of Hamiltonian Chaotic Systems (G M Zaslavsky) Polymer Science Applications of Path-Integration, Integral Equations, and Fractional Calculus (J F Douglas) Applications to Problems in Polymer Physics and Rheology (H Schiessel et al.) Applications of Fractional Calculus Techniques to Problems in Biophysics (F F Nonnenmacher & R Metzler) Fractional Calculus and Regular Variation in Thermodynamics (R Hilfer) Readership: Statistical, theoretical and mathematical physicists. Keywords: Fractional Calculus in Physics Reviews: “This monograph provides a systematic treatment of the theory and applications of fractional calculus for physicists. It contains nine review articles surveying those areas in which fractional calculus has become important. All the chapters are self-contained.” Mathematics Abstracts

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 eighth volume collects authoritative chapters covering several applications of fractional calculus in engineering, life and social sciences, including applications in signal and image analysis, and chaos.

Fractional Differential Equations - Igor Podlubny 1998-10-27

This book is a landmark title in the continuous move from integer to non-integer in mathematics: from integer numbers to real numbers, from factorials to the gamma function, from integer-order models to models of an arbitrary order. For historical reasons, the word 'fractional' is used instead of the word 'arbitrary'. This book is written for readers who are new to the fields of fractional calculus and its applications. The authors have directed their efforts towards reading the book, which is suitable for researchers from applied mathematics and engineering. It is also a valuable resource for graduate students, as well as for scholars looking for new mathematical tools.

Fractional Calculus in Medical and Health Science - Devendra Kumar 2018-07-09

This comprehensive application uses the power of fractional calculus as a tool for modeling human diseases and how to control them. The mathematical results included in the book will be helpful to mathematicians and doctors by enabling them to explain real-life problems accurately. The book will also offer case studies of real-life situations with an emphasis on describing the mathematical results and showing how to apply the book to medical and health science, and at the same time highlighting modeling strategies. The book will be useful to graduate level students, educators and researchers interested in mathematics and medical science.

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 eighth volume collects authoritative chapters covering several applications of fractional calculus in engineering, life and social sciences, including applications in signal and image analysis, and chaos.

The Fractional Calculus - Keith B. Oldham 1974

Advanced Applications of Fractional Differential Operators to Science and Technology - Matouk, Ahmed Ezzat 2020-04-24

Fractional-order calculus dates to the 19th century but has been resurrected as a prevalent research subject due to its provision of more adequate and realistic descriptions of physical aspects within the science and engineering fields. What was once a classical form of mathematics is currently being reintroduced as a new modeling technique that engineers and scientists are finding modern uses for. There is a need for research on all facets of these fractional-order systems and studies of its potential applications. Advanced Applications of Fractional Differential Operators to Science and Technology provides emerging research exploring the theoretical and practical aspects of novel fractional modeling and related dynamical behaviors as well as its applications within the fields of physical sciences and engineering. Featuring coverage on a broad range of topics such as chaotic dynamics, ecological models, and bifurcation control, this book is ideally designed for engineering professionals, mathematicians, physicists, analysts, researchers, educators, and students seeking current research on fractional calculus and other applied mathematical modeling techniques.

Fractional Dynamics - Vasily E. Tarasov 2011-01-04

"Fractional Dynamics: Applications of Fractional Calculus to Dynamics of Particles, Fields and Media" presents applications of fractional calculus, integral and differential equations of non-integer orders in describing systems with long-time memory, non-local spatial and fractal properties. Mathematical models of fractal media and distributions, generalized dynamical systems and discrete maps, non-local statistical mechanics and kinetics, dynamics of open quantum systems, the hydrodynamics and electrodynamics of complex media with non-local properties and memory are considered. The book is intended to meet the needs of scientists and graduate students in physics, mechanics and applied mathematics who are interested in electrodynamics, statistical and condensed matter physics, quantum dynamics, complex media theories and kinetics, discrete maps and lattice models, and nonlinear dynamics and chaos. Dr. Vasily E. Tarasov is a Senior Research Associate at Nuclear Physics Institute of Moscow State University and an Associate Professor at Applied Mathematics and Physics Department of Moscow Aviation Institute.

Advances in the Theory and Applications of Non-integer Order Systems - Wojciech Mitkowski 2012-06-03

This volume presents various aspects of non-integer order systems, also known as fractional systems, which have recently attracted an increasing attention in the scientific community of systems science, applied mathematics, control theory. Non-integer systems have become relevant for many fields of science and technology exemplified by the modeling of signal transmission, electric noise, dielectric polarization, heat transfer, electrochemical reactions, thermal processes, acoustics, etc. The content is divided into six parts, every of which considers one of the currently relevant problems. In the first part the Realization problem is discussed, with a special focus on positive systems. The second part considers stability of certain classes of non-integer order systems without delays. The third part is devoted on such important aspects as controllability, observability and optimization especially in discrete time. The fourth part is focused on distributed systems where non-integer calculus leads to new and interesting results. The next part considers problems of solutions and approximations of non-integer order equations and systems. The final and most extensive part is devoted to applications. Problems from mechatronics, biomedical engineering, robotics and others are all analyzed and solved with tools from fractional systems. This volume came to fruition thanks to high level of talks and interesting discussions at RNHR 2013 - 5th Conference on Non-integer Order Calculus and its Applications that took place at AGH University of Krakow.
Frontiers in Time Scales and Inequalities-George A Anastassiou 2015-08-06 This monograph contains the author’s work of the last four years in discrete and fractional analysis. It introduces the right delta and right nabla fractional calculus on time scales and continues with the right delta and right nabla discrete fractional calculus in the Caputo sense. Then, it shows representation formulae of functions on time scales and presents Ostrowski type inequalities, Landau type inequalities, Grüss type and comparison of means inequalities, all these over time scales. The volume continues with integral operator inequalities and their multivariate vectorial versions using convexity of functions, again all these over time scales. It follows the Grüss and Ostrowski type inequalities involving s-convexity of functions; and also examines the general case when several functions are involved. Then, it presents the general fractional Hermite–Hadamard type inequalities using m-convexity and (s, m)-convexity. Finally, it introduces the reduction method in fractional calculus and its connection to fractional Ostrowski type inequalities is studied. This book’s results are expected to find applications in many areas of pure and applied mathematics, especially in difference equations and fractional differential equations. The chapters are self-contained and can be read independently, and advanced courses can be taught out of it. It is suitable for researchers, graduate students, seminars of the above subjects, and serves well as an invaluable resource for all science libraries. Contents:Foundations of Right Delta Fractional Calculus on Time ScalesPrinciples of Right Nabla Fractional Calculus on Time ScalesAbout Right Delta Discrete FractionalityAbout Right Nabla Discrete Fractional CalculusRepresentations and Ostrowski Inequalities over Time ScalesLandau Inequalities on Time ScalesGrüss and Comparison of MeansInequalities in Time ScalesIntegral Operator Inequalities over Time ScalesAbout Vectorial Integral Operator Inequalities Using Convexity over Time ScalesGeneral Grüss and Ostrowski Inequalities Using s-ConvexityEssential and s-Convexity Ostrowski and Grüss Inequalities Using Several FunctionsGeneral Fractional Hermite–Hadamard Inequalities Using m-ConvexityAbout the Reducition Method in Fractional Calculus and Fractional Ostrowski InequalitiesReadership:Advanced graduate students and researchers interested in time scales, inequalities and difference/differential equations. Key Features: Presents new research on time scales and related inequalities.Materials are crucially related to difference/differential equations.Self-contained chapters that can be read independently An extensive list of references is given in each chapter.The topics covered are diverse.Keywords:Time Scale;Fractional Derivative;Difference Equation;Fractional Inequality

Fractional Dynamical Systems: Methods, Algorithms and Applications-Piotr Kulczycki

Fractional Calculus and Fractional Differential Equations-Varsha Daftardar-Gejji 2009-08-10 This book provides a broad overview of the latest developments in fractional calculus and fractional differential equations (FDEs). It is intended to motivate further research in 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.

DescrIbEr Systems of Integer and Fractional Orders-Tadeusz Kaczorek 2007-05-14 This book is devoted to describe the descriptor integer and fractional order positive continuous-time and discrete-time systems. The book consists of 3 chapters, 4 appendices and the list of references. Chapter 1 is devoted to descriptor integer order continuous-time and discrete-time linear systems. In Chapter 2, descriptor fractional order continuous-time and discrete-time linear systems are considered. Chapter 3 is devoted to the stability of descriptor continuous-time and discrete-time systems of integer and fractional orders. In Appendix A, extensions of the Cayley-Hamilton theorem for descriptor linear systems are given. Some methods for computation of the Drazin inverse are presented in Appendix B. In Appendix C, some basic definitions and theorems on Laplace transforms and Z-transforms are given. Some properties of the nilpotent matrices are given in Appendix D.

New Trends in Fractional Differential Equations with Real-World Applications in Physics-Jagdev Singh 2020-12-30 Advances in Modelling and Control of Non-integer-Order Systems-Krzysztof J. Latawiec 2014-08-16 This volume presents selected aspects of non-integer, or fractional order systems, whose analysis, synthesis and applications have increasingly become a real challenge for various research communities, ranging from science to engineering. The spectrum of applications of the fractional order calculus has incredibly expanded, in fact it would be hard to find a science/engineering-related subject area where the fractional calculus had not been incorporated. The content of the fractional calculus is ranged from pure mathematics to engineering implementations and so is the content of this volume. The volume is subdivided into six parts, reflecting particular aspects of the fractional order calculus. The first part contains a single invited paper on a new formulation of fractional-order descriptor observers for fractional-order descriptor continuous LTI systems. The second part provides new elements to the mathematical theory of fractional-order systems. In the third part of this volume, a bunch of new results in approximation, modeling and simulations of fractional-order systems is given. The fourth part presents new solutions to some problems in controllability and control of non-integer-order system calculus, in particular fractional PID-like control. The fifth part analyzes the stability of non-integer order systems and some new results are offered in this important respect, in particular for discrete-time systems. The final, sixth part of this volume presents a spectrum of applications of the noninteger order calculus, ranging from bi-fractional filtering, in particular of electromyographic signals, through the thermal diffusion and advection, diffusion processes to the SIEMENS platform implementation. This volume's papers were all subjected to stimulating comments and discussions from the active audience of the RRN’2014, the 6th Conference on Non-integer Order Calculus and Its Applications that was organized by the Department of Electrical, Control and Computer Engineering, Opole University of Technology, Opole, Poland.

Mathematical Analysis and Computing-R. N. Mohapatra 2021-05-05 This book is a collection of selected papers presented at the International Conference on Mathematical Analysis and Computing (ICMAC 2019) held at Sri Sivasubramaniam Nadar College, Chennai, India from 23–24 December 2019. Having found its applications in game theory, economics, and operations research, mathematical analysis plays an important role in analyzing models of physical systems and provides a sound logical base for problems stated in a qualitative manner. This book aims at disseminating recent advances in areas of mathematical analysis, soft computing, approximate computing and their applications and relevant topics such as mathematical modeling, fuzzy logic, artificial intelligence, and operations research. The book contains 40 papers all subjected to stimulating comments and discussions from the active audience of the RRNR'2014, the 6th Conference on Non-integer Order Calculus and Its Applications that was organized by the Department of Electrical, Control and Computer Engineering, Opole University of Technology, Opole, Poland.

Basic Theory-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 first volume collects authoritative chapters covering the mathematical theory of fractional calculus, including fractional-order operators, integral transforms and equations, special functions, calculus of variations, and probabilistic and other aspects.

Matrix Methods And Fractional Calculus-Mathai Arak M 2017-11-10 Fractional calculus in terms of mathematics and statistics and its applications to problems in natural sciences is NOT yet part of university teaching curricula. This book is one attempt to provide an approach to include topics of fractional calculus into university curricula. Additionally the material is useful for people who do research work in the areas of special functions, fractional calculus, applications of fractional calculus, and mathematical statistics. Contents: PrefaceList of SymbolsVector/Matrix Derivatives and OptimizationJacobians of Matrix Transformations and Functions of Matrix ArgumentFractional Calculus and Special FunctionsFractional Calculus and Fractional Differential EquationsKober Fractional Calculus and Matrix-Variate FunctionsLie Theory and Special FunctionsSelected Topics in Multivariate Analysis Readership:Graduate students and researchers in all aspects of fractional calculus and its
Discrete Fractional Calculus and Fractional Difference Equations-Rui A. C. Ferreira

New Trends in Nonlinear Dynamics-Walter Lacabanne 2020-01-27 This third of three volumes from the inaugural NODYCON, held at the University of Rome, in February of 2019, presents papers devoted to New Trends in Nonlinear Dynamics. The collection features both well-established streams of research as well as novel areas and emerging fields of investigation. Topics in Volume III include NEMS/MEMS and nanomaterials: multi-sensors, actuators exploiting nonlinear working principles; adaptive, multifunctional, and meta material structures; nanocomposite structures (e.g., carbon nanotube/polymer composites, composites with functionalized nanoparticles); OD, ID, 2D, 3D nanostructures; biomechanics applications, DNA modeling, walking dynamics, heart dynamics, neurodynamics, capsule robots, jellyfish-like robots, nanorobots; cryptography based on chaotic maps; ecosystem dynamics, social media dynamics (user behavior dynamics in multi-messages social hotspots, prediction models), financial engineering, complexity in engineering, and network dynamics (multi-agent systems, leader-follower dynamics, swarm dynamics, biological networks dynamics).

Bifurcation and Chaos in Fractional-Order Systems-Marius-F. Danca 2021-01-19 This book presents a collection of seven technical papers on fractional-order complex systems, especially chaotic systems with hidden attractors and symmetries, in the research front of the field, which will be beneficial for scientific researchers, graduate students, and technical professionals to study and apply. It is also suitable for teaching lectures and for seminars to use as a reference on related topics.

Advanced Mathematical Methods- Francesco Mainardi 2020-02-05 The many technical and computational problems that appear to be constantly emerging in various branches of physics and engineering beg for a more detailed understanding of the fundamental mathematics that serves as the cornerstone of our way of understanding natural phenomena. The purpose of this Special Issue was to establish a brief collection of carefully selected articles authored by promising young scientists and the world’s leading experts in pure and applied mathematics, highlighting the state-of-the-art of the various research lines focusing on the study of analytical and numerical mathematical methods for pure and applied sciences.

Automation 2018-Roman Szewczyk 2018-03-07 This book consists of papers presented at Automation 2018, an international conference held in Warsaw from March 21 to 23, 2018. It discusses the radical technological changes occurring due to the INDUSTRY 4.0, with a focus on offering a better understanding of the Fourth Industrial Revolution. Each chapter presents a detailed analysis of interdisciplinary knowledge, numerical modeling and simulation as well as the application of cyber-physical systems, where information technology and physical devices create synergic systems leading to unprecedented efficiency. The theoretical results, practical solutions and guidelines presented are valuable for both researchers working in the area of engineering sciences and practitioners looking for solutions to industrial problems.

Progress on Difference Equations and Discrete Dynamical Systems-Steve Baigent 2021-01-04 This book comprises selected papers of the 25th International Conference on Difference Equations and Applications, ICDEA 2019, held at UCL, London, UK, in June 2019. The volume details the latest research on difference equations and discrete dynamical systems, and their application to areas such as biology, economics, and the social sciences. Some chapters have a tutorial style and cover the history and more recent developments for a particular topic, such as chaos, bifurcation theory, monotone dynamics, and global stability. Other chapters cover the latest personal research contributions of the author(s) in their particular area of expertise and range from the more technical articles on abstract systems to those that discuss the application of difference equations to real-world problems. The book is of interest to both PhD students and researchers alike who wish to keep abreast of the latest developments in difference equations and discrete dynamical systems.

Theory and Applications of Non-Integer Order Systems-Artur Babiarz

Computational Methods In The Fractional Calculus Of Variations-Riccardo Almeida 2015-03-19 This book fills a gap in the literature by introducing numerical techniques to solve problems of fractional calculus of variations (FCV). In most cases, finding the analytic solution to such problems is extremely difficult or even impossible, and numerical methods need to be used. The authors are well-known researchers in the area of FCV and the book contains some of their recent results, serving as a companion volume to Introduction to the Fractional Calculus of Variations by A B Malinowska and D F M Torres, where analytical methods are presented to solve FCV problems. After some preliminaries on the subject, different techniques are presented in detail with numerous examples to help the reader to better understand the methods. The techniques presented may be used not only to deal with FCV problems but also in other contexts of fractional calculus, such as fractional differential equations and fractional optimal control. It is suitable as an advanced book for graduate students in mathematics, physics and engineering, as well as for researchers interested in fractional calculus.

New Digital Signal Processing Methods-Raoul R. Nigmatullin 2020-05-23 This book is intended as a manual on modern advanced statistical methods for signal processing. The objectives of signal processing are the analysis, synthesis, and modification of signals measured from different natural phenomena, including engineering applications as well. Often the measured signals are affected by noise, distortion and incompleteness, and this makes it difficult to extract significant signal information. The main topic of the book is the extraction of significant information from measured data, with the aim of reducing the data size while keeping the basic information/knowledge about the peculiarities and properties of the analyzed system; to this aim, advanced and recently developed methods in signal analysis and treatment are introduced and described in depth. More in details, the book covers the following new advanced topics (and the corresponding algorithms), including detailed descriptions and discussions: the Eigen Coordinates (ECs) method, the statistics of the fractional moments, The quantitative “universal” label (QUL) and the universal distribution function for the relative fluctuations (UDFRF), the generalized Prony spectrum, the Non-orthogonal Amplitude Frequency Analysis of the Smoothed Signals (NAPASS), the discrete geometrical invariants (DGI) serving as the core of a platform for quantitative comparison of different random functions. Although advanced topics are discussed in signal analysis, each subject is introduced gradually, with the use of only the necessary mathematics, and avoiding unnecessary abstractions. Each chapter presents testing and verification examples on real data for each proposed method. In comparison with other books, here it is adopted a more practical approach with numerous real case studies.

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.

Frontiers in Functional Equations and Analytic Inequalities - George A. Anastassiou 2019-11-23 This volume presents cutting edge research from the frontiers of functional equations and analytic inequalities active fields. It covers the subject of functional equations in a broad sense, including but not limited to the following topics: Hyperstability of a linear functional equation on restricted domains, Hyers–Ulam’s stability results to a three point boundary value problem of nonlinear fractional order differential equations, Topological degree theory and Ulam’s stability analysis of a boundary value problem of fractional differential equations, General Solution and Hyers-Ulam Stability of Duo Trigintic Functional Equation in Multi-

Banach Spaces Stabilities of Functional Equations via Fixed Point Technique Measure zero stability problem for the Drygas functional equation with complex involution Fourier Transforms and Ulam Stabilities of Linear Differential Equations, Hyers-Ulam stability of a discrete diamond-alpha derivative equation, Approximate solutions of an interesting new mixed type additive-quadratic-quartic functional equation. The diverse selection of inequalities covered includes Opial, Hilbert-Pachpatte, Ostrowski, comparison of means, Poincare, Sobolev, Landau, Polya-Ostrowski, Hardy, Hermite-Hadamard, Levinson, and complex Korovkin type. The inequalities are also in the environments of Fractional Calculus and Conformable Fractional Calculus. Applications from this book’s results can be found in many areas of pure and applied mathematics, especially in ordinary and partial differential equations and fractional differential equations. As such, this volume is suitable for researchers, graduate students and related seminars, and all science and engineering libraries. The exhibited thirty six chapters are self-contained and can be read independently and interesting advanced seminars can be given out of this book.