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In the fields of dynamical systems and control theory, a fractional-order system is a dynamical system that can be modeled by a fractional differential equation containing derivatives of non-integer order. Such

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systems are said to have fractional dynamics. Derivatives and integrals of fractional orders are used to describe objects that can be characterized by power-law nonlocality, power-law long-range dependence or fractal properties. Fractional-order systems are useful in studying the anomalous

~~Fractional order system — Wikipedia~~

Discrete-Time Fractional-Order Systems: Modeling and Stability Issues 3 $L a D a t f(t) = dm dt m f 1 G (m a) Z t a f(t) (t t) a m + 1 d t g (3)$ Naturally, as physical systems are modeled by differential equations containing eventually fractional derivatives, it is necessary to give to these equations initial

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conditions that must be physically interpretable.

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modeling are prerequisites to the exercise of automatic control. Therefore, the chief interest for the identification of any dynamic system lies in its applicability to manipulate and control the system completely based on collected data.

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A fractional-order model of energy-saving and emission-reduction system is formulated. The equilibrium points and instability region of the FOESERS are derived. The chaotic behaviours of the FOESERS with chaotic attractors are studied by numerical simulation.

~~Fractional order modeling and sliding mode control of~~

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Fractional-order control (FOC) is a field of control theory that uses the fractional-order integrator as part of the control system design toolkit. The use of fractional calculus (FC) can improve and generalize well-established control methods and strategies. The fundamental advantage of FOC is that the fractional-order integrator weights history using a function that decays with a power-law tail. The effect is that the effects of all time are computed for each iteration of the control ...

~~Fractional order control - Wikipedia~~

In Ref. , the authors presented a model based on a

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fractional order transfer function for electrochemical capacitors (also known as UC or SC), its corresponding EEC is shown in Fig. 4(g), where C_a , C_b are the capacitances of the fractional order capacitors and D is a fractional order element. This transfer function was proposed by interpreting the Bode-Nyquist diagrams obtained from the experimental data of the EIS test.

~~Classical and fractional order modeling of equivalent~~

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vi Analysis, Modeling and Stability of Fractional Order Differential Systems 1 A2A.1y.o or h.t bef asfoiig cnralomng iput..... 21 on oi ttahf Reetpr

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Chapter 2. Frequency Approach to the Synthesis of

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This book introduces an original fractional calculus methodology ('the infinite state approach') which is applied to the modeling of fractional order differential equations (FDEs) and systems (FDSs). Its modeling is based on the frequency distributed fractional integrator, while the resulting model corresponds to an integer order and infinite dimension state space representation.

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Supplementary This book aims to propose the implementation and application of Fractional Order Systems (FOS). It is well known that FOS can be utilized in control applications and systems modeling, and their effectiveness has been proven in many theoretical works and simulation routines.

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Buy Fractional-order Modeling and Control of Dynamic Systems (Springer Theses) 1st ed. 2017 by Aleksei Tepljakov (ISBN: 9783319529493) from Amazon's Book Store. Everyday low prices and free delivery on

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~~Fractional-order Modeling and Control of Dynamic Systems ...~~

It has been found that the fractional-order derivatives have a wide range of applications in the modeling of many asynchronous dynamic processes, such as engineering, biology, medicine and many other fields [26-30].

~~A fractional-order SEIHDR model for COVID-19 with inter ...~~

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fractional order chaotic systems accompanied by Matlab programs for simulating their state space trajectories, which are shown in the illustrations in the book.

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Fractional Order Systems: Optimization, Control, Circuit Realizations and Applications consists of 21 contributed chapters by subject experts. Chapters offer practical solutions and novel methods for recent research problems in the multidisciplinary applications of fractional order systems, such as FPGA, circuits, memristors, control algorithms, photovoltaic systems, robot manipulators, oscillators,

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This book reports on an outstanding research devoted to modeling and control of dynamic systems using fractional-order calculus. It describes the development of model-based control design methods...

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CONTROL | Aleksei ...~~

Nonlinear Bergman's minimal model representing this system is taken, and converted to fractional-order model using the Caputo definition. After that, method

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of feedback linearization is put forward for fractional-order nonlinear systems, and then applied to design observer based controller for an artificial pancreas for a patient with diabetes.

"Fractional-Order Nonlinear Systems: Modeling, Analysis and Simulation" presents a study of fractional-order chaotic systems accompanied by Matlab programs for simulating their state space trajectories, which are shown in the illustrations in the book. Description of the chaotic systems is clearly presented and their analysis and numerical solution

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are done in an easy-to-follow manner. Simulink models for the selected fractional-order systems are also presented. The readers will understand the fundamentals of the fractional calculus, how real dynamical systems can be described using fractional derivatives and fractional differential equations, how such equations can be solved, and how to simulate and explore chaotic systems of fractional order. The book addresses to mathematicians, physicists, engineers, and other scientists interested in chaos phenomena or in fractional-order systems. It can be used in courses on dynamical systems, control theory, and applied mathematics at graduate or postgraduate level. Ivo Petráš is an Associate Professor of

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Automatic control and the Director of the Institute of Control and Informatization of Production Processes, Faculty of BERG, Technical University of Košice, Slovak Republic. His main research interests include control systems, industrial automation, and applied mathematics.

This book aims to propose implementations and applications of Fractional Order Systems (FOS). It is well known that FOS can be applied in control applications and systems modeling, and their effectiveness has been proven in many theoretical works and simulation routines. A further and mandatory step for FOS real world utilization is their

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hardware implementation and applications on real systems modeling. With this viewpoint, introductory chapters on FOS are included, on the definition of stability region of Fractional Order PID Controller and Chaotic FOS, followed by the practical implementation based on Microcontroller, Field Programmable Gate Array, Field Programmable Analog Array and Switched Capacitor. Another section is dedicated to FO modeling of Ionic Polymeric Metal Composite (IPMC). This new material may have applications in robotics, aerospace and biomedicine.

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Fractional Order Systems: Optimization, Control, Circuit Realizations and Applications consists of 21 contributed chapters by subject experts. Chapters offer practical solutions and novel methods for recent research problems in the multidisciplinary applications of fractional order systems, such as FPGA, circuits, memristors, control algorithms, photovoltaic systems, robot manipulators, oscillators, etc. This book is ideal for researchers working in the modeling and applications of both continuous-time and discrete-time dynamics and chaotic systems. Researchers from academia and industry who are working in research areas such as control engineering, electrical engineering, mechanical

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engineering, computer science, and information technology will find the book most informative.

Discusses multi-disciplinary applications with new fundamentals, modeling, analysis, design, realization and experimental results Includes new circuits and systems based on the new nonlinear elements Covers most of the linear and nonlinear fractional-order theorems that will solve many scientific issues for researchers Closes the gap between theoretical approaches and real-world applications Provides MATLAB® and Simulink code for many of the applications in the book

This book reports on an outstanding research devoted

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to modeling and control of dynamic systems using fractional-order calculus. It describes the development of model-based control design methods for systems described by fractional dynamic models. More than 300 years had passed since Newton and Leibniz developed a set of mathematical tools we now know as calculus. Ever since then the idea of non-integer derivatives and integrals, universally referred to as fractional calculus, has been of interest to many researchers. However, due to various issues, the usage of fractional-order models in real-life applications was limited. Advances in modern computer science made it possible to apply efficient numerical methods to the computation of fractional

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derivatives and integrals. This book describes novel methods developed by the author for fractional modeling and control, together with their successful application in real-world process control scenarios.

Fractional-order Systems and Controls details the use of fractional calculus in the description and modeling of systems, and in a range of control design and practical applications. It is largely self-contained, covering the fundamentals of fractional calculus together with some analytical and numerical techniques and providing MATLAB® codes for the simulation of fractional-order control (FOC) systems. Many different FOC schemes are presented for control

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and dynamic systems problems. Practical material relating to a wide variety of applications is also provided. All the control schemes and applications are presented in the monograph with either system simulation results or real experimental results, or both. Fractional-order Systems and Controls provides readers with a basic understanding of FOC concepts and methods, so they can extend their use of FOC in other industrial system applications, thereby expanding their range of disciplines by exploiting this versatile new set of control techniques.

This book explains the essentials of fractional calculus and demonstrates its application in control system

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modeling, analysis and design. It presents original research to find high-precision solutions to fractional-order differentiations and differential equations. Numerical algorithms and their implementations are proposed to analyze multivariable fractional-order control systems. Through high-quality MATLAB programs, it provides engineers and applied mathematicians with theoretical and numerical tools to design control systems. Contents Introduction to fractional calculus and fractional-order control Mathematical prerequisites Definitions and computation algorithms of fractional-order derivatives and Integrals Solutions of linear fractional-order differential equations Approximation of fractional-

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order operators Modelling and analysis of multivariable fractional-order transfer function Matrices State space modelling and analysis of linear fractional-order Systems Numerical solutions of nonlinear fractional-order differential Equations Design of fractional-order PID controllers Frequency domain controller design for multivariable fractional-order Systems Inverse Laplace transforms involving fractional and irrational Operations FOTF Toolbox functions and models Benchmark problems for the assessment of fractional-order differential equation algorithms

Fractional order calculus is finding increasing interest

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In the control system community, Hardware realizations of fractional order controllers have sparked off a renewed zeal into the investigations of control system design in the light of fractional calculus. As such many notions of integer order LTI systems are being modified and extended to incorporate these new concepts. Computational Intelligence (CI) techniques have been applied to engineering problems to find solutions to many hitherto intractable conundrums and is a useful tool for dealing with problems of higher computational complexity. This book borders on the interface between CI techniques and fractional calculus, and looks at ways in which fractional order control

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systems may be designed or enhanced using CI based paradigms. To the best of the author's knowledge this is the first book of its kind exclusively dedicated to the application of computational intelligence techniques in fractional order systems and control. The book tries to assimilate various existing concepts in this nascent field of fractional order intelligent control and is aimed at researchers and post graduate students working in this field.

Mathematical Techniques of Fractional Order Systems illustrates advances in linear and nonlinear fractional-order systems relating to many interdisciplinary applications, including biomedical, control, circuits,

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electromagnetics and security. The book covers the mathematical background and literature survey of fractional-order calculus and generalized fractional-order circuit theorems from different perspectives in design, analysis and realizations, nonlinear fractional-order circuits and systems, the fractional-order memristive circuits and systems in design, analysis, emulators, simulation and experimental results. It is primarily meant for researchers from academia and industry, and for those working in areas such as control engineering, electrical engineering, computer science and information technology. This book is ideal for researchers working in the area of both continuous-time and discrete-time dynamics and chaotic

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systems. Discusses multidisciplinary applications with new fundamentals, modeling, analysis, design, realization and experimental results Includes circuits and systems based on new nonlinear elements Covers most of the linear and nonlinear fractional-order theorems that will solve many scientific issues for researchers Closes the gap between theoretical approaches and real-world applications Provides MATLAB® and Simulink code for many applications in the book

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

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sixth volume collects authoritative chapters covering several applications of fractional calculus in control theory, including fractional controllers, design methods and toolboxes, and a large number of engineering applications of control.

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