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1st International Conference on Frontiers in Computational Physics: Modeling the Earth System

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Basic theory of fractional differential equations

Fractional Cauchy problems on bounded domains

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Prof. Ralf Metzler
Updated Information

Researchers & Groups: Prof. Virginia Kiryakova

Below is the updated list of "selected papers" by Prof. Virginia Kiryakova:

Criteria for univalence of the Dziok-Srivastava and the Srivastava-Wright operators in the class A
Kiryakova Virginia
APPLIED MATHEMATICS AND COMPUTATION Volume: 218 Issue: 3 Special Issue: SI Pages: 883-892, DOI: 10.1016/j.amc.2011.01.076, Published: OCT 1 2011

Recent history of fractional calculus
Machado J. Tenreiro; Kiryakova Virginia; Mainardi Francesco
COMMUNICATIONS IN NONLINEAR SCIENCE AND NUMERICAL SIMULATION Volume: 16 Issue: 3 Pages: 1140-1153, DOI: 10.1016/j.cnsns.2010.05.027, 2011

The multi-index Mittag-Leffler functions as an important class of special functions of fractional calculus
Kiryakova Virginia
COMPUTERS & MATHEMATICS WITH APPLICATIONS Volume: 59 Issue: 5 Special Issue: SI Pages: 1885-1895, DOI: 10.1016/j.camwa.2009.08.025, 2010

The special functions of fractional calculus as generalized fractional calculus operators of some basic functions
Kiryakova Virginia
COMPUTERS & MATHEMATICS WITH APPLICATIONS Volume: 59 Issue: 3 Pages: 1128-1141, DOI: 10.1016/j.camwa.2009.05.014, 2010

A brief story about the operators of generalized fractional calculus
Kiryakova Virginia
FRACT. CALC. APPL. ANAL. Volume: 11 Issue: 2 Pages: 203-220

Solutions of fractional multi-order integral and differential equations using a Poisson-type transform
Ali Ismail; Kiryakova Virginia; Kalla Shyam L
JOURNAL OF MATHEMATICAL ANALYSIS AND APPLICATIONS Volume: Issue: 1 Pages: 172-199, DOI: 10.1016/S0022-247X(02)00012-4, Published: 2002

A multi-index Borel-Dzrbashjan transform
Al-Musallam F, Kiryakova V, Tuan VK
ROCKY MOUNTAIN JOURNAL OF MATHEMATICS Volume: 32 Issue: 2 Pages: 409-428, DOI: 10.1216/rmjm/1030539678, Published: 2002
The Obrechkoff integral transform: Properties and relation to a generalized fractional calculus
Dimovski I.; Kiryakova, V
NUMERICAL FUNC. ANAL. AND OPTIMIZATION Volume: 21 Issue: No 1-2 Pages 121-144,
DOI: 10.1080/01630560008816944, Published: 2000

All the special functions are fractional differintegrals of elementary functions
Kiryakova Virginia
J. PHYSICS A: MATH. & GENERAL Volume: 30, Issue: 14 Pages: 5085-5103, DOI:
10.1088/0305-4470/30/14/019, Published: 1997

Conferences

1st International Conference on Frontiers in Computational Physics: Modeling the Earth System

Abstract submission deadline - 13 July 2012
Boulder, CO, USA 16 - 20 December 2012

Computational science complements the classical paradigm of theory and observation, and leads where neither is available. In particular, computational models play an essential role in diagnosis and prognosis of all elements of the Earth System, from solar variability through space weather, geomechanics, terrestrial climate and weather, down to ground water flow. This inaugural four-day Conference on Frontiers in Computational Physics will provide a forum for exchanging and sharing experiences, knowledge and on advanced computational techniques, methods, and models for simulation of the Earth System. With computational aspects in focus, the physical emphasis is on natural problems that are complex, coupled and multiscale.

Themes

-Global systems and complexity models
-Global and regional climate, uncertainty quantification
-Solar variability and space weather
-Weather, deep atmosphere, planetary boundary layer, air quality
-Ocean, anisotropy, eddy resolving computations
-Water cycle, glaciology, ground water flow
-Geology and geomechanics
-Multiscale interactions, turbulence, extreme events, subgrid-scale parameterizations
The conference will consist of several plenary invited talks, together with contributions from all fields above, organized in parallel sessions. A part of sessions will be reserved for "topical sessions" proposed by their conveners.

A call for papers related to the conference theme will be made shortly after the meeting; these papers will be considered for publication, undergoing the usual review process, in a topical issue of the Journal of Computational Physics.

Books

Fractional Order Motion Controls

Ying Luo, YangQuan Chen


Covering fractional order theory, simulation and experiments, this book explains how fractional order modelling and fractional order controller design compares favourably with traditional velocity and position control systems. The authors systematically compare the two approaches using applied fractional calculus. Stability theory in fractional order controllers design is also analysed.

- Presents material suitable for a variety of real-world applications, including hard disk drives, vehicular controls, robot control and micropositioners in DNA microarray analysis
- Includes extensive experimental results from both lab bench level tests and industrial level, mass-production-ready implementations
- Covers detailed derivations and numerical simulations for each case
- Discusses feasible design specifications, ideal for practicing engineers

The book also covers key topics including: fractional order disturbance cancellation and adaptive learning control studies for external disturbances; optimization approaches for nonlinear system control and design schemes with backlash and friction. Illustrations and experimental validations are included for each of the proposed control schemes to enable readers to develop a clear understanding of the approaches covered, and move on to apply them in real-world scenarios.

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20 Lateral Directional Fractional Order Control of A Small Fixed-Wing UAV
21 Fractional Order PD Controller Synthesis and Implementation for HDD Servo System

Introduction to the Fractional Calculus of Variations

Delfim F M Torres, Agnieszka B Malinowska
http://www.worldscibooks.com/mathematics/p871.html

This invaluable book provides a broad introduction to the fascinating and beautiful subject of Fractional Calculus of
Variations (FCV). In 1996, FVC evolved in order to better describe non-conservative systems in mechanics. The inclusion of non-conservatism is extremely important from the point of view of applications. Forces that do not store energy are always present in real systems. They remove energy from the systems and, as a consequence, Noether's conservation laws cease to be valid. However, it is still possible to obtain the validity of Noether's principle using FCV. The new theory provides a more realistic approach to physics, allowing us to consider non-conservative systems in a natural way. The authors prove the necessary Euler–Lagrange conditions and corresponding Noether theorems for several types of fractional variational problems, with and without constraints, using Lagrangian and Hamiltonian formalisms. Sufficient optimality conditions are also obtained under convexity, and Leitmann's direct method is discussed within the framework of FCV.

The book is self-contained and unified in presentation. It may be used as an advanced textbook by graduate students and ambitious undergraduates in mathematics and mechanics. It provides an opportunity for an introduction to FCV for experienced researchers. The explanations in the book are detailed, in order to capture the interest of the curious reader, and the book provides the necessary background material required to go further into the subject and explore the rich research literature.

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- The Classical Calculus of Variations
- Fractional Calculus of Variations via Riemann–Liouville Operators
- Fractional Calculus of Variations via Caputo Operators
- Other Approaches to the Fractional Calculus of Variations
- Towards a Combined Fractional Mechanics and Quantization

Readership: Advanced undergraduate, graduate students and researchers in mathematics, physics, operations research and applied sciences.

Chaos, Solitons & Fractals

Volume 45, Issue 7

Robust filtering of uncertain stochastic genetic regulatory networks with time-varying delays
Wenqin Wang, Shouming Zhong, Feng Liu
Two characteristics of planar intertwined basins of attraction
Changming Ding

On the nesting of Painlevé hierarchies: A Hamiltonian approach
A. Pickering

Spread of disease in a patchy environment
Junli Liu

Chaos of several typical asymmetric systems
Jingjing Feng, Qichang Zhang, Wei Wang

Three-dimensional modulation of electron-acoustic waves: 3 + 1 Davey–Stewartson system
P. Carbonaro

Global stability analysis of epidemiological models based on Volterra–Lyapunov stable matrices
Shu Liao, Jin Wang

Multiscale recurrence analysis of long-term nonlinear and nonstationary time series
Yun Chen, Hui Yang

Chaos evidence in catecholamine secretion at chromaffin cells
G. Quiroz, I. Bonifas, J.G. Barajas-Ramirez, R. Femat

Periodic and chaotic synchronizations of two distinct dynamical systems under sinusoidal constraints
Fuhong Min, Albert C.J. Luo

Some new results on stability of fixed points
S.N. Mishra, S.L. Singh, Rajendra Pant

Describing some characters of serine proteinase using fractal analysis
Xin Peng, Wei Qi, Rongxin Su, Zhimin He

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Asymptotic bubble evolutions of the Rayleigh–Taylor instability
Sung-Ik Sohn

Stochastic control of attractor preference in a multistable system
B.E. Martínez-Zérega, A.N. Pisarchik

One-Time Pad as a nonlinear dynamical system
Nithin Nagaraj

Articles

Existence and uniqueness results for fractional integrodifferential equations with boundary value conditions
K. Karthikeyan, J.J. Trujillo

The finite-dimensional super integrable system of a super NLS-mKdV equation
Qiu-Lan Zhao, Yu-Xia Li, Xin-Yue Li, Ye-Peng Sun

On solutions of third and fourth-order time dependent Riccati equations and the generalized Chazy system
Partha Guha, A. Ghose Choudhury, Barun Khanra

Lie symmetries and conservation laws of the Hirota–Ramani equation
Mehdi Nadjafikhah, Vahid Shirvani-Sh

Almost automorphic solutions to some damped second-order differential equations
Toka Diagana

Hyperbolic and trigonometric solutions for some nonlinear evolution equations
Mohammed K. Elboree

Solution of the Thomas–Fermi equation with a convergent approach
M. Turkyilmazoglu

Elliptic traveling waves of the Olver equation
Nikolai A. Kudryashov, Mikhail B. Soukharev, Maria V. Demina

A KdV-like advection–dispersion equation with some remarkable properties
Abhijit Sen, Dilip P. Ahalpara, Anantanarayanan Thyagaraja, Govind S. Krishnaswami

The Sinc–Legendre collocation method for a class of fractional convection–diffusion equations with variable coefficients
Abbas Saadatmandi, Mehdi Dehghan, Mohammad-Reza Azizi

The bifurcation and exact peakons, solitary and periodic wave solutions for the Kudryashov–Sinelshchikov equation
Bin He, Qing Meng, Yao Long
Homotopy analysis method for MHD viscoelastic fluid flow and heat transfer in a channel with a stretching wall
Behrouz Raftari, Kuppalapalle Vajravelu

Unsteady flow and heat transfer in a thin film of Ostwald–de Waele liquid over a stretching surface
K. Vajravelu, K.V. Prasad, Chiu-On Ng

On the paradoxical behavior of a cyclic device working with a non-Boltzmannian fluid
D. Fanelli, G. De Ninno, A. Turchi

Effects of slip on steady Bödewadt flow of a non-Newtonian fluid
Bikash Sahoo, Sébastien Poncet

Flow distribution and environmental dispersivity in a tidal wetland channel of rectangular cross-section

Effects of heat generation/absorption on stagnation point flow of nanofluid over a surface with convective boundary conditions
A. Alsaeedi, M. Awais, T. Hayat

Formation patterns at the air-grain interfaces in spinning granular films at high rotation rates
Piroz Zamankhan

Numerical solutions of transonic two-dimensional flows at a ninety-degree wedge
Eun Heui Kim, Chung-min Lee

On the use of lattice Boltzmann model for simulating dean flow of non-Newtonian fluids in curved square ducts
Ali Salehi-Shabestari, Kayvan Sadeghy, Mehrdad Raisee

Uncertainty propagation in stochastic fractional order processes using spectral methods: A hybrid approach
Pham Luu Trung Duong, Moonyong Lee

Finding safety in partially controllable chaotic systems
Juan Sabuco, Samuel Zambrano, Miguel A.F. Sanjuán, James A. Yorke

Spiral wave death, breakup induced by ion channel poisoning on regular Hodgkin–Huxley neuronal networks
Jun Ma, Long Huang, Jun Tang, He-Ping Ying, Wu-Yin Jin

Information dynamics algorithm for detecting communities in networks
Emanuele Massaro, Franco Bagnoli, Andrea Guazzini, Pietro Lió

Algebraic approach for the exploration of the onset of chaos in discrete nonlinear dynamical systems
Minvydas Ragulskis, Zenonas Navickas, Rita Palivonaite, Mantas Landauskas

Particle swarm optimization with chaotic opposition-based population initialization and stochastic search technique
Wei-feng Gao, San-yang Liu, Ling-ling Huang
Integrated circuit generating 3- and 5-scroll attractors

Transient chaos and crisis phenomena in butterfly valves driven by solenoid actuators
Peiman Naseradinmousavi, C. Nataraj

Complete controllability of fractional evolution systems
JinRong Wang, Yong Zhou

Period-three route to chaos induced by a cyclic-fold bifurcation in passive dynamic walking of a compass-gait biped robot
Hassène Gritli, Nahla Khraief, Safya Belghith

Active sliding observer scheme based fractional chaos synchronization
Danial Mohammadi Senejohnny, Hadi Delavari

On the natural solution of an impulsive fractional differential equation of order $q \in (1, 2)$
JinRong Wang, Xuezhu Li, Wei Wei

A new synchronization algorithm for delayed complex dynamical networks via adaptive control approach
Xiaoyong Guo, Junmin Li

Robust synchronization of singular complex switched networks with parametric uncertainties and unknown coupling topologies via impulsive control
Meng Yang, Yan-Wu Wang, Jiang-Wen Xiao, Yuehua Huang

Projective lag synchronization of the general complex dynamical networks with distinct nodes
Xiangjun Wu, Hongtao Lu

The explosive divergence in iterative maps of matrices
Zenonas Navickas, Minvydas Ragulskis, Alfonsas Vainoras, Rasa Smidtaite

A modified coupled map car following model and its traffic congestion analysis
Hong-Xia Ge, Yu-Xia Liu, Rong-Jun Cheng, Siu-Ming Lo

Modelling and properties of a nonlinear autonomous switching system in fed-batch culture of glycerol
Juan Wang, Qingying Sun, Enmin Feng

Optimal sliding mode control of single degree-of-freedom hysteretic structural system
Mehdi Baradaran-nia, Ghasem Alizadeh, Sohrab Khanmohammadi, Bahman Farahmand Azar

A closed-form solution for nonlinear oscillation and stability analyses of the elevator cable in a drum drive elevator system experiencing free vibration
R. Mirabdollah Yani, R. Ghodsi, E. Darabi
Parametric resonance in the Rayleigh–Duffing oscillator with time-delayed feedback
M. Siewe Siewe, C. Tchawoua, S. Rajasekar

On the application of the homotopy analysis method to limit cycles’ approximation in planar self-excited systems
Huaxiong Chen, Jianhe Shen, Zheyan Zhou

Letters to the Editors

Periodic wave solutions of coupled integrable dispersionless equations by residue harmonic balance
A.Y.T. Leung, H.X. Yang, Z.J. Guo

Comments on “Similarity variables and reduction of the heat equation on torus” [Commun Nonlinear Sci Numer Simulat 2012;17:1251–57]
M.T. Mustafa

Fractional Calculus and Applied Analysis

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New issue: Volume 15, Issue 3, 2012 – Contents:

FCAA related meetings, books, in memoriam (FCAA – Volume 15 – No 3)
Virginia Kiryakova (Editorial Note)

State space solution of implicit fractional continuous time systems
Djillali Bouagada, Paul Van Dooren

Fractional differential inclusions with fractional separated boundary conditions
Bashir Ahmad, Sotiris K. Ntouyas

Spectral approximations to the fractional integral and derivative
Changpin Li, Fanhai Zeng, Fawang Liu

Towards a combined fractional mechanics and quantization
Agnieszka B. Malinowska, Delfim F. M. Torres

A fractional imbedding theorem
Dariusz Idczak, Stanislaw Walczak
Velocity and displacement correlation functions for fractional generalized Langevin equations
Trifce Sandev, Ralf Metzler, Zivorad Tomovski

Anti-periodic fractional boundary value problems with nonlinear term depending on lower order derivative
Bashir Ahmad, Juan J. Nieto

Product rule for vector fractional derivatives
Diogo Bolster, Mark M. Meerschaert, Alla Sikorskii

The fBm-driven Ornstein-Uhlenbeck process: Probability density function and anomalous diffusion
Caibin Zeng, YangQuan Chen, Qigui Yang

A Fourier generalized convolution transform and applications to integral equations
Nguyen Xuan Thao, Vu Kim Tuan, Nguyen Thanh Hong

Uniqueness of positive solutions of fractional boundary value problems with non-homogeneous integral boundary conditions
John R. Graef, Lingju Kong, Qingkai Kong, Min Wang

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Classical Papers
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Basic theory of fractional differential equations

V. Lakshmikanthama, A.S. Vatsala


Abstract. In this paper, the basic theory for the initial value problem of fractional differential equations involving Riemann-Liouville differential operators is discussed employing the classical approach. The theory of inequalities, local existence, extremal solutions, comparison result and global existence of solutions are considered.

[FBack]
Abstract

Fractional Cauchy problems replace the usual first-order time derivative by a fractional derivative. This paper develops classical solutions and stochastic analogues for fractional Cauchy problems in a bounded domain $D \subset \mathbb{R}^d$ with Dirichlet boundary conditions. Stochastic solutions are constructed via an inverse stable subordinator whose scaling index corresponds to the order of the fractional time derivative. Dirichlet problems corresponding to iterated Brownian motion in a bounded domain are then solved by establishing a correspondence with the case of a half-derivative in time.
Awards:
- MINERVA Amos de Shalit fellow
- Alexander von Humboldt Feodor Lynen fellow
- DFG Emmy Noether I fellow
- Finland Distinguished Professor

Research topics:
- The statistical and nonequilibrium behaviour of biopolymers, such as DNA/RNA, proteins and enzymes, and their interactions. This includes the study of the denaturation transition of double-stranded DNA, in particular under the influence of an external, longitudinal pulling force. Investigating the dynamics of localized, intermittent denaturation zones, and their interactions with the (un)binding dynamics of proteins that specifically bind to single-stranded DNA. Developing models to combine the mechanisms involved in gene regulation both in vitro and in vivo.

- Generic aspects of search strategies, in particular, the effect of scale-free search mechanisms. These provide searching agents with a means to escape the central limit theorem and avoid oversampling, which is the major shortcoming of Brownian search strategies in one and two dimensions. In fact, search strategies involving scale-free trajectories have been found in cases ranging from facilitated diffusion in in vitro gene regulation, to the foraging behaviour of bacteria and spider monkeys.

- Anomalous stochastic processes, such as Lévy flights and subdiffusion. This research involves collaboration with experimental groups using single molecule fluorescence, optical tweezers, and atomic force microscopy. We also collaborate with a number of theoretical groups in several countries.

Selected Papers:
5. Cottone Giulio; Di Paola Mario; Metzler Ralf, Fractional calculus approach to the statistical characterization of random variables and vectors, PHYSICA A-STATISTICAL MECHANICS AND ITS APPLICATIONS, Vol. 389, No. 5, 2010
8. Metzler Ralf; Chechkin Aleksei V.; Gonchar Vsevolod Yu.; et al., Some fundamental aspects of Levy flights, Conference: Denton Workshop on In Search of a Theory of Complexity held in Honor of Radu Balescu Location: Denton, TX Date: AUG, 2005