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EDITORIAL

Special issue on "Fractional calculus and applications"

Fractional calculus originally arose from the need of defining non-integer order differential operators. The significance of the fractional calculus has been demonstrated to be very effective in various contexts; for example in elasticity, continuum mechanics, quantum mechanics, signal analysis, and some other branches of pure and applied mathematics like nonlinear analysis and nonlinear dynamics.

The fractional differential equations were applied to investigate some anomalous still unsolved problems which appear in science and engineering thus enabling us to face many challenging problems such as non-linear problems, scale depending problems, non-integer dimensional problems, and non-differentiable function. The analytical, numerical methods and the fractional integral transforms can be used to deal with these types of equations.

The main aim of this special issue is to focus on recent and novel developments and achievements in the theory of fractional calculus and its applications. The collected papers give a short but meaningful description of the main hot problems in physics and mathematics and are investigating a broad range of problems in many different topics.

Fractional calculus with applications in mathematical physics is the topics developed in the paper of Lenzi et al. on the "Solutions for a fractional diffusion equation: Anomalous diffusion and adsorption–desorption processes". In his paper Hristov studies "A unified nonlinear fractional equation of the diffusion-controlled surfactant adsorption: Reappraisal and new Solution of the Ward-Tordai Problem". The paper "A fractional model for dye removal" is investigated by Ji-Huan He et al. while Duan et al. gives a description of the "Levy stable distribution and space-fractional Fokker–Planck type equation". In the same topics of application in mathematical physics there are the paper of Espinosa-Paredes et al. on "Time-fractional telegraph equation for hydrogen diffusion during severe accident in BWRs", the paper of Manuel et al. on "Steady-state Response of Constant Coefficient Discrete-Time Differential Systems" and the paper of Tarasov on "Discrete model of dislocations in fractional nonlocal elasticity".

The second main topics considered in this issue were focusing on analytical and numerical methods for fractional ODEs, PDEs, integral equations and integro-differential equations with linear or nonlinear term. Several papers are devoted to this field, like the paper of Wang et al. on "Generalized variational formulations for extended exponentially fractional integral", the paper of Sweilam et al. "On the numerical solution of space fractional order diffusion equation via shifted Chebyshev polynomials of the third kind", the paper of Ray on "A new analytical modelling for nonlocal generalized Riesz fractional sine-Gordon equation". The paper of Jafari et al. deals with the "Study of fractional order Van der Pol equation" thus showing the importance of fractional calculus in the analysis of dynamical systems. In the same subject, important contributions are given by Elbeleze et al. with her paper on "Approximate solution of integro-differential equation of fractional (arbitrary) order", by Mehmet and Timuçin with the paper "On the perturbation-iteration algorithm for fractional differential equations". Fundamental theoretical problems are considered in the paper of C. Cattani and E. Guariglia with the "Fractional derivative of the Hurwitz zeta-function and chaotic decay to zero", in the paper of Jain et al. on "Certain recent fractional integral inequalities associated with the hypergeometric operators", Benkhettou et al. with the paper "Existence and uniqueness of solution for a fractional Riemann–Liouville initial value problem on time scales" and with the paper "A conformable fractional calculus on arbitrary time scales". Some fundamental theoretical problems are considered in the papers of Wu et al. on "Mittag–Leffler function for discrete fractional modelling" and Abdulla et al. on "On the existence and uniqueness of solutions for a class of non-linear fractional boundary value problems". In almost all papers the Authors give some examples and applications. A particular application of fractional calculus in Economics is given by Phaochoo et al. with his paper on "The meshless local Petrov–Galerkin based on moving kriging interpolation for solving fractional Black–Scholes model".

We have tried to select some of the main high level contributions in all domains of this broad research area, nevertheless

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we believe that the topics of this issue are growing very fast and thanks to the important contribution to science given by the fractional calculus by attracting a larger community of scholars.

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