Editorial

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Special issue on advances in fractional dynamics in mechanical engineering

Fractional calculus theory has important applications of dynamical systems in various fields, such as physics, mechanics, signal processing, system control, and bioengineering, especially where nonlinear dynamics occurs. The dynamical systems of fractional order with the help of the concepts of scales and fractals attract researchers from many areas of science and technology, ranging from heat transfer to mechanical engineering. At present, there are still some intriguing unsolved theoretical problems in fractional dynamics, whereas there are many different fractional models in applications from different definitions of fractional derivatives, which are utilized to describe the complex systems with differentiability or non-differentiability, power law, long-range memory, and irregular sets like fractals.

This Special Issue has handled a limited but dense domain of the fractional calculus theory by giving a presentation of the more recent scientific achievements and showing some of the more attracting attempts to extend the fractional calculus applications to nonlinear dynamics, in both theoretical and applied aspects. Among the many submitted manuscript, a small selection of paper has been accepted after peer review. However, these papers were ranging on the fields of interest from theoretical point of views to more practical applications. Theoretical aspects of the engineering applications were studied in the papers devoted to numerical methods in differential equations and investigation of the solutions of fractional order equations. These methods and theoretical approaches can be found in the papers, such as "Modified Sumudu Decomposition Method for Lane-Emden Type Differential Equations," by Eltayeb et al.; "Reduced Differential Transform Method for Partial Differential Equations within Local Fractional Derivative Operators," investigated by Jafari et al.; and "A fractional model to describing the Brownian motion of particles and its analytical solution" by Yao et al., which describes the study of the Brownian motion in the presence of fractional order derivatives. "A modified homotopy analysis method for solution of fractional wave equations" by Yin et al. describes the fractional wave equation by combining the homotopy method with some more recent techniques.

The uncertainty in fractional order equations is investigated in the paper "A new fractional derivative for differential equation of fractional order under interval uncertainty" by Salahshour et al. Another very efficient numerical method such as the Adomian decomposition is studied in the paper "Fast Adomian decomposition method for the Cauchy problem of the time-fractional reaction-diffusion equation" by Shi, et al., while an interesting analysis of the heat flow is considered in the paper "Local fractional variational iteration algorithm II for non-homogeneous model associated with the non-differentiable heat flow" by Zhang et al. Some papers were dealing on more concrete engineering applications, like the electric circuits. Some interesting papers, such as "Fractional Electrical Circuits" by Alsaedi et al., "Numerical solution for the model of RLC circuit via the fractional derivative without singular kernel" by Atangana et al., and "Extension of the RLC electrical circuit to fractional derivative without singular kernel" Atangana et al., deal with this subject. These three papers surely do not fill the gap in this particular field but certainly open new perspectives in research. The remaining papers of this issue deal with some challenging topics such as fractional controller: "ESO-based fractional order PID controller for a novel electro-hydraulic servo system with iso-actuation balancing and positioning" by Gao, et al., "Balancing and Positioning for a Gun Control System Based on Fuzzy Fractional Order PID Strategy" by Gao et al., and "Visualizing Control Systems Performance: A fractional perspective" by Lopes, et al. Boring machines and fractional isolation system are studied in the papers "Simulation of rock fragmentation induced by a tunnel boring machine disc cutter" by Li et al. and "Optimal

design for fractional-order active isolation system" by You et al., respectively.

Engineering applications in medicine would also benefit from a suitable approach based on fractional calculus. As shown in the paper "Computer-aided Diagnosis of Abnormal Breasts in Mammogram Images by Weighted-Type Fractional Fourier Transform" by Zhang et al., there are many possible applications of the fractional order operators for a better analysis of complex problems.

The main aim is of this issue was to establish an international forum to present the newest and novel developments and achievements in several branches of mechanical engineering. We succeeded in this task by giving in this issue only a small but significant sample of possible applications. We believe that it is not enough, but this issue describes some possible applications of fractional calculus and it will be a milestone for future research, thus opening new frontiers in research and applications.

Xiao-Jun Yang[1], António Mendes Lopes[2], Jordan Yankov Hristov[3], Carlo Cattani[4], Dumitru Baleanu[5] and Syed Tauseef Mohyud-Din[6]

[1]School of Mechanics and Civil Engineering, China University of Mining and Technology, Xuzhou, China

[2]Institute of Mechanical Engineering, University of Porto, Porto, Portugal

[3]Department of Chemical Engineering, University of Chemical Technology and Metallurgy, Sofia, Bulgaria

[4]Engineering School (DEIM), Tuscia University, Viterbo, Italy

[5]Faculty of Arts and Sciences, Çankaya University, Ankara, Turkey

[6]Faculty of Science, HITEC University, Taxila, Pakistan