fractal and fractional

Editorial

Editorial for Special Issue "Fractional Calculus Operators and the Mittag–Leffler Function"

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Among the numerous applications of the theory of fractional calculus in almost all applied sciences, applications in numerical analysis and various fields of physics and engineering stand out. Applications of inequalities involving function integrals and their derivatives, as well as applications of fractional differentiation inequalities, have motivated many researchers to investigate extensions and generalizations using various fractional differential and integral operators. Of particular importance is the Mittag–Leffler function which, with its generalizations, appears as a solution to differential or integral equations of fractional order. This produced new results for more generalized fractional integral operators containing the Mittag–Leffler function in their kernels.

This Special Issue contains 15 published papers. In [1], the authors use derivatives of fractional order, which are based on generalized kernels of the Mittag–Leffler type, to present three models of fractional order. These models involve fractional ordinary and partial differential equations. The accuracy of the solution was checked in comparison with the exact solution and by calculating the residual error function.

The asymptotic behavior of random time changes in dynamical systems is studied in [2]. As time varies randomly, three classes are proposed that show different patterns of asymptotic decay.

In [3], the authors showed that the static magnetization curve of highly concentrated ferrofluids can be accurately approximated by the Mittag–Leffler function of the inverse external magnetic field.

By introducing two series of new numbers and their derivatives [4], and choosing to use six well-known generalized Kummer addition formulas, the authors establish six classes of generalized addition formulas and demonstrate six identities regarding finite sums.

The paper [5] deals with the existence and uniqueness of the solution for the Hilfer–Hadamard fractional differential equation, supplemented with mixed non-local boundary conditions.

In [6], the authors developed some new recurrence relations for two parametric Mittag–Leffler functions and discussed some applications of these recurrence relations. By applying Riemann–Liouville fractional integrals and differential operators, four new relations between Fox–Wright functions with certain special cases are established.

The goal of the paper [7] was to find new versions of Fejér–Hadamard-type inequalities for $(\alpha, h-m)-p$-convex functions by means of expanded fractional operators with Mittag–Leffler functions. These inequalities hold at the same time for different types of convexities and different types of fractional integrals.

In [8], a new approach is given for solving a class of first-order fractional initial value problems. The results are based on the Riemann–Liouville fractional derivative and the solutions are expressed in terms of Mittag–Leffler, exponential, and trigonometric functions.

The paper [9] aims to define an operator that contains the Mittag–Leffler function in its kernel, which leads to the deduction of many already existing operators. The results of

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this work reproduce Chebyshev- and Pólya-Szegö-type inequalities for various fractional integral operators.

In [10], the authors investigate certain image formulas related to the product of Srivastava polynomials and extended Wright functions using fractional integral and differential operators, including Marichev–Saigo–Maeda, Lavoie–Trottier, and Oberhettinger.

The paper [11] reviews the mathematical model of chlorine transport used as a water treatment model, when variable-order partial derivatives are included to describe the chlorine transfer system. In this paper, a new analytical solution using Mittag–Leffler functions is presented.

Hermite–Hadamard inequalities for κ-Riemann–Liouville fractional integrals are presented in [12], using a newer approach based on the Abel–Gontscharoff green function. The authors established certain integral identities and obtained new results for monotone functions.

The paper [13] investigates the Dirichlet and modified Dirichlet average of the R function, i.e., the Mittag–Leffler-type function. They are given in terms of Riemann–Liouville integrals and hypergeometric functions of several variables.

Hermite–Hadamard fractional integral inequalities for the class of $(h, g; m)$-convex functions are presented in [14]. The expanded generalized Mittag–Leffler function is contained in the kernel of applied fractional integral operators.

In [15], a new fractional Poisson process is proposed using a recursive fractional differential equation. The arrival time distribution functions are derived, while the inter-arrival times are no longer independent and identically distributed.

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