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Editorial

Discrete Dynamics of Fractional Systems: Theory and Numerical Techniques

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In recent decades, fractional calculus has found a large number of profound applications, which have triggered the development of both the theory and methods for more reliable discretization and approximations of the dynamics of continuous systems. Fractional order models and discretized problems are nonlocal. They provide better descriptions of and, ultimately, deeper insights into underlying complex phenomena in sciences and technologies. Novel new analytical approaches have become a key to the study of qualitative properties of the aforementioned fractional systems and the existence and uniqueness of their nonlocal solutions.

Continuous models based on systems of ordinary or partial differential equations have been investigated under proper criteria of discretization in this special issue. Novel numerical approximations of solutions of fractional systems are also investigated. In fact, the search for discrete techniques which are faster and stable, that possess higher orders of convergence at lower computational costs, and that preserve the main features of the solutions of interest has been a constant pursuit in numerical analysis. To this end, this special issue pays a special attention to the discretization of continuous fractional systems that preserve important characteristics including the positivity, boundedness, convexity, monotonicity, and energy of the underlying systems.

The 8 research papers in this special issue are highly selective. These high-quality papers represent the latest developments in the theory of discrete fractional systems and the discretization of fractional differential equations arising from sciences and technologies. The final contributed papers focus on issues like

(i) Lebesgue-p norm convergence analysis of PD$^{\alpha}$-type iterative learning control for fractional order nonlinear systems,

(ii) solution existence for initial-value problems of hybrid fractional sum-difference equations,

(iii) homotopy series solutions to time-space fractional coupled systems,

(iv) numerical simulations of one-dimensional fractional nonsteady heat transfer models based on the second kind Chebyshev wavelet,

(v) numerical analysis of fractional order epidemic models of childhood diseases,

(vi) weak solutions for partial random Hadamard fractional integral equations with multiple delays,

(vii) modified function projective synchronization for a partially linear and fractional order financial chaotic system with uncertain parameters,

(viii) two new approximations for variable order fractional derivatives.

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