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Editorial

Dynamical Processes and Systems of Fractional Order

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Processes and systems of fractional order recently attract research interests. This special issue collects 18 papers with respect to dynamical processes and systems of fractional order, their computations, and their applications.

Fractional-order models and problems are the main focus of this issue. The recent progress in calculus and symbolic computation has open new frontiers in Engineering applications, in Physics, and in Technology, thus enabling facing challenging problems such as nonlinear problems, scale depending problems, noninteger dimensional problems, and nondifferentiable functions. In different fields of research, there is an urgent demand for fractals; for instance, new materials with extreme mechanical behavior or traffic optimization problems in communications can be suitably investigated by using fractal theory and beyond. Fractal theory, originally based on the analysis of functions with strange behaviors like the self-similar functions or the recursively defined unsmooth paths, which fill in the plane, was developing in the last decade by handling more complex fractal-like phenomena in science, nature, and biology. For instance, fractals in science were studied in signals, communications, and fractures in materials. Fractals in nature arise along the coast line, geomorphology, and tree branches. Fractals in biology were observed and studied in the heath beats, blood vessels, brain activity, and DNA. There follows that nearly every phenomenon in nature, when observed at a suitable scale or investigated by a scientific model, looks like a fractal and the corresponding model is fractional.

M. Li and W. Zhao's paper entitled "*Solving Abel's type integral equation with Mikusinski's operator of fractional order*" gives a novel explanation of the integral equation of Abel's type from the point of view of Mikusinski's operational calculus. Y.-M. Wang's paper "*Maximum norm error estimates of ADI methods for a two-dimensional fractional subdiffusion equation*" discusses two alternating direction implicit finite difference methods for solving a two-dimensional fractional subdiffusion equation, providing an explicit error estimate for each of the two methods in the discrete maximum norm. J.-S. Duan's paper "*The periodic solution of fractional oscillation equation with periodic input*" exhibits that their results are similar to the case of a damped oscillation with a periodic input in the integer-order case. In addition, the paper introduces the fractional resonance frequency. The paper by X.-M. Yang and Z.-L. Deng that is in the title "*A point source identification problem for a time fractional diffusion equation*" develops an effective numerical algorithm to recover both the intensities and locations of unknown point sources from final measurements when an inverse source identification problem for a time fractional diffusion equation is considered.

The paper by M. H. Heydari et al. is entitled "*Chebyshev wavelets method for solution of nonlinear fractional integrodifferential equations in a large interval.*" It develops an efficient Chebyshev wavelets method for solving a class of nonlinear fractional integrodifferential equations in a large interval and presents a new technique for computing nonlinear terms in equations of such type. L. Liu's paper entitled "*Interval wavelet numerical method on Fokker-Planck equations for nonlinear random system*" proposes an interval wavelet numerical method for nonlinear random systems using interval

Shannon-Gabor wavelet interpolation operator. Two types of equations, namely, a Fokker-Planck-Kolmogorov equation for nonlinear oscillators and a time fractional Fokker-Planck equation, are taken as examples to illustrate the effectiveness and efficiency of the proposed method. S.-L. Mei and D.-H. Zhu's paper entitled "*Interval Shannon wavelet collocation method for fractional Fokker-Planck equation*" presents a method of an adaptive interval interpolation wavelet.

The paper by H. S. Alkhaldi et al., entitled "*Vibration control of fractionally-damped beam subjected to a moving vehicle and attached to fractionally-damped multiabsorbers*," presents promising results in mechanics and theoretic physics with respect to the dynamic response of Bernoulli-Euler homogeneous isotropic fractionally damped simply supported beam. The paper by S. Wen et al., which is entitled "*The study of fractional order controller with SLAM in the humanoid robot*," presents a fractional-order PI controller with SLAM method. The proposed method was used in the simulation of navigation of NAO humanoid robot from Aldebaran.

Z. Wang and L. Yan's paper "*The S-transform of sub-fBm and an application to a class of linear subfractional BSDEs*" studies be a subfractional Brownian motion with index $0 < H < 1$. M. Li's paper entitled "*Power spectrum of generalized fractional Gaussian noise*" gives the Fourier transform of the generalized fractional Gaussian noise (GfGn). By GfGn, one means that the autocorrelation function of GfGn is equipped with fractional lag. Hence, it is a kind of noise equipped with two indexes, the Hurst parameter $0 < H < 1$ and the index of fractional lag that is less than or equals 1 but greater than 0.

Z. Liao's paper with the title "*Low-dosed X-ray computed tomography imaging by regularized fully spatial fractional-order Perona-Malik diffusion*" proposes a new fractional-order Perona-Malik Diffusion (FOPMD) algorithm for noise suppressing. The algorithm has the advantages of both regularization and FOPMD. It has good abilities in singularities preserving while suppressing noise. S. Hu's paper entitled "*External fractional-order gradient vector Perona-Malik diffusion For sinogram restoration of low-dosed X-ray computed tomography*" presents a novel fractional-order diffusion scheme, named external fractional-order gradient vector Perona-Malik diffusion, which has advantage in avoiding artifacts, dark resulting images, and speckle effect. The paper by W.-S. Chen et al. is entitled "*Geometric distribution weight information modeled using radial basis function with fractional order for linear discriminant analysis method*." It introduces the radial basis function (RBF) with fractional order to model the geometric distribution weight information of the training samples and proposes a novel geometric distribution weight information-based Fisher discriminant criterion. The paper by B. Chen et al. entitled "*A fast region-based segmentation model with Gaussian kernel of fractional order*" proposed the Gaussian kernel of fractional order for image processing. The paper by J. Yang et al. "*Extraction of affine invariant features using fractal*" presents an approach for extracting affine invariant features based on fractal for object classification.

The paper by W. Huang et al., in the title of "*Distance-based routing strategy for traffic transport in spatial networks*," proposes a novel distance-based routing strategy in spatial scale-free networks. X. Sun and J. Liu's paper "*Weak convergence for a class of stochastic fractional equations driven by fractional noise*" gives the analysis of the issue about the weak convergence of a class of stochastic fractional equations with the excitation of fractional Gaussian noise.

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