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Editorial

Propagation Phenomena and Transitions in Complex Systems 2012

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An increasing challenge in advanced engineering applications based on efficient mathematical models for propagation and transition phenomena can be noticed nowadays. Fractal theory and special mathematical functions are used in modeling very small-scale material properties (energy levels and induced transitions) for the design of nanostructures. Differential geometry is adapted for solving nonlinear partial differential equations with very great number of variables for modeling dynamics and transitions in complex optoelectronics systems. Propagation aspects implying commutative and/or additive consequences of quantum physics are used extensively in the design of long-range transmission systems. Time series with extremely high-transmission rates are used for multiplexed transmission systems for large communities, such as traffic in computer networks or transportations, financial time series, and time series of fractional order in general. All these advanced engineering subjects require efficient mathematical models in the development of classical tools for complex systems. The objective in such applications is to take into consideration efficiency aspects of mathematical and physical models required by basic phenomena of propagation and transitions in complex systems, when specific limitations are involved (very long distance propagation phenomena, fractal aspects and transitions in nanostructures, and complex systems with great number of variables and infinite spatiotemporal extension of material media). Using advanced mathematical tools for modeling propagation and transition phenomena, this special issue presents high qualitative and innovative developments for eficient mathematical approaches of propagation phenomena and transitions in complex

systems. Significant results were obtained in the research fields of low-scale physical structures, propagation of waves in advanced materials, dynamics of complex systems, and efficient signal and image analysis based on fundamental mathematical and physical laws.

This special issue involves 19 original papers, selected by the editors so as to present the most significant results in the previously mentioned topics. These papers are organised as follows:

(a) Three papers on specific fractal approach for oscillation, propagation and diffusion properties of low-scale structures: "*Fractional calculus and Shannon wavelets*" by C. Cattani, "*Simplicial approach to fractal structure*" by I. Bochicchio, C. Cattani, and E. Laserra, and "*Sinogram restoration for low-dosed x-ray computed tomography using fractional-order perona-malik diffusion*" by S. Hu, Z. Liao, and W. Chen.

(b) Four papers on specific methods for analysis of complex movements: "*Cutting afine moment invariants*" by J. Yang, M. Li, Z. Chen, and Y. Chen, "*Dual-ekf based real-time celestial navigation for lunar rover*" by L. Xie, P. Yang, T. T. Yang, and M. Li, "*Parallel motion simulation of large-scale real-time crowd in a hierarchical environmental model*" by X. Wang, J. Zhang, and M. Scalia, and "*Hidden Markov models based dynamic hand gesture recognition*" by X. Wang, M. Xia, H. Cai, Y. Gao, and C. Cattani.

(c) Five papers on accurate and efficient mathematical models for propagation phenomena: "*Gaussian curvature in propagation problems in physics and engineering*" by E. G. Bakhoum, "*Multidimensional wave field signal theory: transfer function relationships*" by N. Baddour, "*Homotopy perturbation method and variational iteration method for harmonic waves propagation in nonlinear magneto-thermoelasticity with rotation*" by S. M. Abo-Dahab, K. A. Gepreel, and T. A. Nofal, "*Mathematical models of dissipative systems in quantum engineering*" by A. Sterian and P. Sterian, and "*Stable one-dimensional periodic wave in kerr-type and quadratic nonlinear media*" by R. Savastru, S. Dontu, D. Savastru, M. Tautan, and V. Babin.

(d) Three papers on mathematical tools for analyzing the dynamics of complex systems: "*Solving linear coupled fractional differential equations by direct operational method and some applications*" by S. C. Lim, M. Li, C. H. Eab, K. H. Mak, and S. y. Chen, "*Difference-equation-based digital frequency synthesizer*" by L. T. Ko, J. E. Chen, Y. S. Shieh, H. C. Hsin, and T. Y. Sung, and "*Fast detection of weak singularities in a chaotic signal using Lorenz system and the bisection algorithm*" by T. Song and C. Cattani.

(e) Two papers on efficient image analysis based on fundamental mathematical and physical laws: "*Kernel optimization for blind motion deblurring with image edge prior*" by J. Wang, K. Lu, Q. Wang, and J. Jia, and "*Power-law properties of human view and reply behavior in online society*" by Y. Wu, Q. Ye, J. Xiao, and L. Li.

(f) Two papers on scaling and optimization aspects: "*Kernel optimization for blind motion deblurring with image edge prior*" by F. Pop, and "*Study of the fractal and multifractal scaling intervening in the description of fracture experimental data reported by the classical work*" by C. L. Violeta and D. Iordache.

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