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Editorial

Dynamics of complex systems: present and future

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Abstract This special issue contains 17 regular articles The broad spectrum of scientific directions include the study of dynamics in complex systems, in non-equilibrium systems, in quantum systems including condensed matter and photonic ones, and also active and biological systems, earth climate, and even aspects of machine learning.

The study of nonlinear dynamics, by itself an established field, led to the emergence of concepts of complexity and the insight that complex systems are governed by more than the sum of their parts. The corresponding dynamics of complex systems is a much younger field or research, and it continues to expand from initial subfields such as active systems to quantum physics, condensed matter and photonics, machine learning and climate dynamics. This process is certainly driven the quest for novel technologies and new generation devices based on nanostructured materials with unprecedented electrical, mechanical, optical and other properties such as graphene, nanotubes, quantum dot arrays, metamaterials, trapped atomic condensates, superconducting networks, plasmonic and nanophotonic structures on the one side, the quest for quantum computers and quantum computing and artifical intelligence on the other side, and the need to deeply understand climate dynamics to master the challenges of the future. There is an increasingly strong demand for new theoretical concepts, approaches and computational tools for uncovering fundamental processes and dynamics in such systems and designing efficient methods of their control.

This special issue is a crosscut through this impressive broad science, motivated and triggered by the slow post-COVID return to in-person meetings, in particular, in East Asia. It contains new results from traditional research directions, e.g., on hyperchaotic systems with hidden attractors, extended Sprott C systems, fluid dynamics, the utilization of chaotic maps together with memristors, nonequilibrium stochastic thermodynamics, ratchets, neuronal networks and on nonlinear waves and solitons, among others. Quantum science is covered by studies of quantum error correction, quantum chaos, quantum thermodynamics and dissipative dipolar systems. Even dynamics days topics have their boundaries, and even then there is research crossing the boundaries and connecting different topics, as demonstrated by image recognition based on chaotic systems and DNA operation rules, and also on resource competition effects on evolution and adaptive radiation. We are sure that the successful story of understanding and unraveling the dynamics of complex systems will continue and lead us to new surprising results and insights.

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