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PREFACE: DYNAMICAL SYSTEMS AND RELATED TOPICS

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Special Issue on Dynamical Systems and Related Topics
dedicated to Professor Leonid Bunimovich on the occasion of his 75th birthday

This special issue on Dynamical Systems and Related Topics is dedicated to Professor Leonid Bunimovich on the occasion of his 75th birthday.

Professor Leonid Bunimovich (born 1947) is an outstanding Soviet-American mathematician who has made fundamental contributions to the theory of dynamical systems, statistical physics, and their applications. He received his bachelor's degree in 1967, master's degree in 1969, and his PhD in 1973 from the University of Moscow, where his master's and doctoral advisor was Yakov G. Sinai. In 1986, he was awarded the Doctor of Sciences degree in Theoretical and Mathematical Physics by the Academy of Sciences of the USSR in Kyiv. Bunimovich is currently a Regents' Professor of Mathematics at the Georgia Institute of Technology. During 1990–1991, he served as the Volkswagen Professor of Physics at Bielefeld University. He is a Fellow of the Institute of Physics and a recipient of the Humboldt Prize in Physics.

Professor Bunimovich is best known for discovering a fundamental mechanism of chaos in dynamical systems referred to as the mechanism of defocusing. This discovery was a striking and unexpected development not only to mathematicians but also to the physics community. Perhaps the most famous class of systems exhibiting this mechanism is the class of billiard systems, particularly focusing chaotic billiards such as the Bunimovich stadium, Bunimovich flowers, and elliptic flowers. He also introduced the so-called Bunimovich mushrooms, which provide visual examples of billiards exhibiting the coexistence of regular and chaotic dynamics.

Beyond billiard systems, Leonid Bunimovich has made significant contributions across a broad range of applications. He introduced and investigated hierarchical models of human populations, which clarified statistical laws governing the distribution of hereditary diseases and helped explain migration patterns in industrial regions of developed countries. In fluid dynamics, he discovered trapping mechanisms for internal waves in non-homogeneous stratified fluids and analyzed the resulting wave dynamics. This work provided an explanation for several previously puzzling observations regarding internal waves in oceanographic data.

In joint work with Ya. G. Sinai, Bunimovich pioneered rigorous studies of space-time chaos, proving that this type of chaos can arise in systems composed of weakly interacting, time-chaotic components. Together with Ben Webb, he introduced and developed the theory of isospectral transformations for the analysis of multidimensional dynamical systems and networks. This framework enables the analysis of complex networks via their coarse-grained representations and can be used to reveal both their hierarchical structure and hidden symmetries. Bunimovich has also

been a pioneer in the rigorous theory of finite-time dynamics and finite-time prediction for strongly chaotic and random systems. In collaborative work with Skums and Khudyakov, he discovered the phenomenon of local immunodeficiency, demonstrating how viral populations can cooperate to evade the immune response of the human organism.

Leonid Bunimovich is the author of three books and approximately 160 research papers, and he has supervised twelve PhD students.

In this special issue, we present papers authored by a select group of experts in dynamical systems and its applications. The issue features eleven contributions from researchers representing Brazil, Canada, France, Israel, Italy, Poland, Russia, the United Kingdom, and the USA. These papers address a broad spectrum of significant problems and current research topics, including Benford's law in dynamical systems; inheritance of shadowing for dynamical semigroups; generality of blow-up for complex Li-Sinai solutions of the 3D incompressible Navier-Stokes equations from computer simulations; integro-differential equations with the logarithmic Laplacian and drift; rounded triangular billiards; Scheglov's upper bound on the complexity of triangular billiards; two time-dependent billiards; hyperbolicity and ergodicity in randomly perturbed billiard systems; Baire category of generic sets for hyperbolic dynamical systems; twist coefficients of periodic orbits of Minkowski billiards; and Ginzburg-Landau functionals in the large-graph limit.

We hope that this special issue proves valuable to mathematicians interested in recent advances in dynamical systems and their wide-ranging applications.

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