Preface

This book contains a series of chapters, contributed in honor of the 80th birthday of Professor Ronald E. Mickens (Distinguished Callaway Professor of Physics Emeritus, Clark Atlanta University, Georgia, USA), that address some of the current challenges and advances on the study of the mathematical and computational modeling of real-life phenomena arising in population biology and nonlinear oscillation. Professor Mickens is renowned for his stellar contributions in nonlinear oscillations and computational mathematics, particularly the design and analysis of robust and dynamically-consistent *nonstandard finite difference* methods for discretizing continuous-time dynamical systems arising from the mathematical modeling of phenomena in the natural and engineering sciences. The papers contained in this volume are contributed by collaborators of, and researchers whose work was inspired by the works of, Professor Mickens. Some of the contributors spoke at the AMS Special Session on Advances in the Applications of Nonstandard Finite Difference Methods, January 6-9, 2021, Atlanta, Georgia.

The volume contains papers in three main areas, notably the design, analysis and applications of nonstandard finite difference discretization of continuous-time dynamical systems in the natural and engineering sciences, mathematical population biology (with emphasis on the design, analysis, parameterizations of mathematical models for gaining insight into the transmission dynamics and control of emerging and re-emerging infectious diseases, such as COVID-19 and malaria), and nonlinear oscillations. The volume is a collection of 16 papers, containing some new results and techniques. In particular, the papers highlight numerous new advances and challenges associated with the design of dynamically-consistent discrete-time models for approximating the solutions of differential equations (both ordinary and partial), based on Mickens's nonstandard finite-difference discretization framework. Some new higher-order techniques for designing nonstandard finite-difference methods for phenomena in the biological and chemical processes, as well as a generalized autonomous dynamical system, are proposed. Furthermore, the volume contains papers that focus on the design and analysis of robust models for gaining insight and understanding on the spread and mitigation of infectious diseases. In particular, the book contains chapters on modeling the spread and control of the 2019 novel Coronavirus pandemic (COVID-19, which represents the greatest public health problem human have faced since the 1918/1919 influenza pandemic), on the development of a novel genetic-epidemiology modeling framework for malaria disease (the most important parasitic disease of mankind) and a discrete-time epidemic model with Ricker growth. The book also contains papers on mathematical ecology, including works on the effects of temperature and prescribed fire on the dynamics of tick-borne diseases, discretization of models for microbial population with environmental stress, Monod kinetics with half saturation in a chemostat setting etc. Each of the papers is peer-reviewed by at least two anonymous reviewers.

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