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PREFACE

This special issue is dedicated to the 70th birthday of Glenn F. Webb. The topics of the 12 articles appearing in this special issue include evolutionary dynamics of population growth, spatio-temporal dynamics in reaction-diffusion biological models, transmission dynamics of infectious diseases, modeling of antibiotic-resistant bacteria in hospitals, analysis of Prion models, age-structured models in ecology and epidemiology, modeling of immune response to infections, modeling of cancer growth, etc. These topics partially represent the broad areas of Glenn's research interest.

The special issue begins with two essays, *The Work of Glenn F. Webb*, by William E. Fitzgibbon, and *Studying Microbiology with Glenn F. Webb*, by Martin J. Blaser, respectively. As one of Glenn's former Ph.D. students and a long time collaborator, Dr. Fitzgibbon gave a detailed introduction on Glenn's work chronologically, beginning with Glenn's first paper on the representation of nonlinear nonexpansive semi-groups. The listed 165 papers by Glenn cover a very broad spectrum of topics, from theoretical nonlinear semigroups, functional differential equations, infinite dimensional dynamical systems to applied mathematical population dynamics, mathematical biology, and biomedical mathematics. Dr. Blaser, Director of the NYU Human Microbiome Program at New York University School of Medicine and a researcher in microbiology and infectious diseases, provides vivid and instructive descriptions about their collaborations on various timely and emerging problems, such as the persistence of *Helicobacter pylori*, the outbreaks of Anthrax and SARS, etc. In particular, he presents some first hand information about how Glenn was given the problems, then thought about the problems, modeled the problems, and finally solved the problems. This is very beneficial for graduate students and young researchers in learning how to collaborate with biologists and medical doctors and how to tackle real problems. These also echo Fitzgibbon's opinion that "Glenn's work is distinguished by a clarity and accessibility of exposition, a precise identification and description of the problem or model under consideration, and thorough referencing. He uses elementary methods whenever possible but couples this with an ability to employ power abstract methods when necessitated by the problem."

In his paper Cushing investigates an evolutionary game theoretic model for a population subject to predation and a strong Allee threshold of extinction by using Poincaré-Bendixson theory. The model is a nonlinear planar autonomous system whose state variables are population density and the mean of a phenotypic trait, which is subject to Darwinian evolution, that determines the population's inherent growth rate. By using Poincaré-Bendixson theory it was found that orbits equilibrate, that the extinction set shrinks when evolution occurs, and that the meant trait component of survival equilibria occur at maxima of the inherent growth rate.

Motivated by modeling ticks, vectors of some infectious diseases, Fan, Lou, Thieme and Wu study an ODE model formulated for populations with many stages. Their identify a basic reproduction number that acts as a threshold between population extinction and persistence, establish conditions for the existence and uniqueness

of nonzero equilibria, and show that their local stability cannot be expected in general. Interestingly, for such an ODE model, boundedness of solutions remains an open problem.

In the paper by Alamir, Nenaah and Hafiz, probit and logistic models are employed to fit experimental mortality data of the Khapra beetle, one of the worst pests of stored grains when fumigated with three plant oils. Estimated data using the probit model were more accurate in terms of L^2 errors between observed and predicted mortality values, than the logistic model. Results of the predicted mortality obtained from the two models could help in continuing to use relatively safe, fast and effective strategy for the control of this serious pest, and thus help safeguard world-wide grain supplies.

Studying a diffusive plant-herbivore system with homogeneous and nonhomogeneous Dirichlet boundary conditions, Wang, Watmough and Yu establish the stability of spatially homogeneous steady states and derive conditions ensuring the occurrence of Hopf bifurcation and steady state bifurcation. They also observe interesting transient spatio-temporal behaviors including oscillations in one or both of space and time through numerical simulations.

In next paper, Ai and Wang are interested in the existence of the traveling bands to the Keller-Segel model with cell population growth in the form of chemical uptake kinetics. They find that when the cell growth is considered, the profile of traveling bands, the minimum wave speed and the range of the chemical consumption rate for the existence of traveling wave solutions will change. Their results demonstrate that collective interaction of cell growth and chemical consumption rate plays an essential role in the generation of traveling bands which provide new insights into the mechanisms underlying the chemotactic pattern formation of wave bands.

Many inverse problems are about choosing best parameter values of a given mathematical model based on fits to measured data, which are usually formulated as optimization problems and the accuracy of their solutions depends on both the chosen optimization scheme and the given data. Banks, Rubio, Saintier and Troparevsky consider an electromagnetic interrogation problem, specifically one arising in an electroencephalography (EEG) problem, of finding optimal number and locations for sensors for source identification in a 3D unit sphere from data on its boundary. They compare the use of the classical D-optimal criterion for observation points as opposed to that for a uniform observation mesh and discuss location and best number of sensors and report results based on statistical uncertainty analysis of the resulting estimated parameters.

In their article, Browne and Webb develop a model to describe epidemic bacterial infections in hospitals by incorporating the infection of patients and the contamination of healthcare workers due to environmental causes. They analyze the model with respect to the asymptotic behavior of solutions and their results can be interpreted to provide insight for controlling these nosocomial epidemics.

Gabriel considers a model that Glenn and his collaborators (M. L. Greer, P. van den Driessche, L. Wang, and G. F. Webb, SIAM J. Appl. Math., 68 (2007), 154–170) proposed to describe prion proliferation assuming general incidence rate of the total population of polymers on the polymerization process. Combining a recent spectral gap result for the growth-fragmentation equation in weighted L^1 spaces and the analysis of a nonlinear system of three ordinary differential equations, he discusses the global stability of the steady states.

There is strong clinical evidence that indicates a correlation between the prevalence of HSV-2 and the perseverance of the HIV epidemic. Kapitanov, Alvey, Vogt-Geisse and Feng construct a model of the co-infection dynamics between the two diseases by incorporating a time-since-infection variable to track the alternating periods of infectiousness of HSV-2. The model includes only heterosexual relationships and distinguishes three population groups: males, general population females, and female sex workers. After carrying out some mathematical analysis of the model, they conduct sensitivity analysis to examine the role of model parameters in influencing the model outcomes.

The study of Kim, Crivelli, Choi, Yun, and Wares addresses the combined effects of viral oncolysis and T-cell mediated oncolysis. They use a mathematical model of virotherapy that induces release of cytokine IL-12 and co-stimulatory molecule 4-1BB ligand and find that the model closely matches previously published data, and while viral oncolysis is fundamental in reducing tumor burden, increased stimulation of cytotoxic T cells leads to a short-term reduction in tumor size, but a faster relapse. They also find that combinations of specialist viruses that express either IL-12 or 4-1BBL might initially act more potently against tumors than a generalist virus that simultaneously expresses both, but the advantage is likely not large enough to replace treatment using the generalist virus. Their results show that virotherapy appears to be optimizable through targeted design and treatment combinations to substantially improve therapeutic outcomes.

During viral infections of cells, it has been found that mutual interference among viruses occurs and the well-known Beddington-DeAngelis function in population dynamics can be used to describe such mutual interference. In their paper, Yang, Ruan and Xiao study an age-structured virus dynamics model with Beddington-DeAngelis infection function. They give an explicit formula for the basic reproductive number R_0 of the model and discuss the global behavior of the model in terms of R_0 : if $R_0 \leq 1$, then the infection-free equilibrium is globally asymptotically stable, whereas if $R_0 > 1$, then the infection equilibrium is globally asymptotically stable. Some special cases, which reduce to some known HIV infection models studied by other researchers, are considered.

In the last paper, Rutter, Ramey, Martirosyan, Kostelich, Kuang, and Preul provide state of the art and interdisciplinary surveys on mathematical modeling on the growth of gliomas to practical use. Morphologically, gliomas show different characteristics that may allow their growth stage and invasive properties to be predicted, and various models have been proposed to offer insight about how these attributes are manifested visually. They review recent models that have been used to predict the efficacy of certain treatment modalities and discuss exactly how they should be administered relative to each other. They also provide images obtained by numerical simulations that are crucial in simulating clinically relevant tumors and determining their influence on the surrounding anatomical structures in the brain.

Finally, we would like to thank all contributors for making this issue a success and all reviewers for their timely review of the manuscripts submitted to this special issue.

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