

FROM THE GUEST EDITORS

This special issue of Mathematical Biosciences and Engineering contains selected papers which were presented at the US-SA Workshop on “Mathematical Methods in Systems Biology and Population Dynamics” held at the African Institute for Mathematical Sciences (AIMS) in Muizenberg, South Africa, January 4-7, 2012. The workshop was originally planned as a small US-SA meeting, but with the growing interest of participants from other countries, we ended up with about 60 participants representing 16 countries from Europe, Africa and even Asia and Australia. Topics addressed at the workshop included the spread of infectious diseases and the growing need for robust and reliable models in ecology, both of special importance in the host country of South Africa where research naturally has been focused on fighting disease and epidemics like HIV/AIDS, malaria and others. In the US, on the other hand, a strong emphasis exists on systems biology and on its aspects related to cancer. Therefore, a second focus area of the workshop was on improved and more realistic models for the dynamic progression and treatment of various types of cancer, a truly globally challenging problem. We would also like to take the opportunity to thank all the sponsors: the National Science Foundation and the Society for Mathematical Biology from the US side, the National Research Foundation of South Africa with institutional support of AIMS, the University of KwaZulu-Natal, Durban and Southern Illinois University Edwardsville for making this event possible.

Following the kind invitation of Yang Kuang, we decided to put together this volume as a special issue of the journal Mathematical Biosciences and Engineering. This volume includes only the original research papers based on the presentations by the workshop participants; all papers underwent the standard refereeing process of the MBE. The twenty six articles contained in this special issue represent a large spectrum of topics. They illustrate applications of methods and tools from various fields of mathematics to systems biology and population dynamics. The modeling approaches range from ODE to PDE to hybrid, discrete-continuous systems and in addition to deterministic models also include stochastic ones. A large number of papers address modeling of various aspects of cancer including carcinogenesis, growth, migration, invasion and tumor immune system interactions. Emphasis is given to the development and analysis of models for particular cancers like cancer of bladder, prostate or glioma. In other papers, models are analyzed from the point of view of applying and optimizing various cancer treatment approaches ranging from traditional chemotherapy to the newer approach of oncolytic viruses. On the other side of the spectrum, there are papers addressing problems more specific to the African continent like spread and treatment of infectious diseases. These topics are discussed both in the general framework of epidemiology models as well as in a more specific way focused on diseases like HIV, malaria or sleeping sickness caused by the tse-tse fly. There are also papers concerning related issues coming from the US like a modeling approach to the invasion of the tick-borne pathogen or to the spread of infection in citrus groves in Florida. In this context, the important issues of data

collection and sensitivity analysis are also considered. Other topics discussed in this volume include different interesting biological and biomedical applications like hemodynamics and cerebral aneurysms, analysis of epileptic seizures through EEG data and the role of calcium waves. Some topics have a more general biological appeal like birth-death processes, analysis of spatial adaptation models or modeling behavior of bacteria on surfaces. In addition to the mathematical methods and models, also some statistical approaches are presented ranging from the analysis of cancer data to data for the growth of the phytoplankton.

With the variety of biological challenges and the wealth of mathematical tools presented in this volume we hope that the readers of MBE will find these articles interesting and possibly inspiring for their own research. We would like to thank all the authors for their valuable contributions and to the referees for their tremendous work of reviewing the manuscripts. Special thanks to Yang Kuang for making this publication possible.

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Guest Editors:

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