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PREFACE

This volume was inspired by the topics presented at the international conference Micro and Macro Systems in Life Sciences which was held on Jun 8-12, 2015 in Będlewo, Poland. System biology is an approach which tries to understand how micro systems, at the molecular and cellular levels, affect macro systems such as organs, tissue and populations. Thus it is not surprising that a major theme of this volume evolves around cancer and its treatment. Articles on this topic include models for tumor induced angiogenesis, without and with delays, metastatic niche of the bone marrow, drug resistance and metronomic chemotherapy, and virotherapy of glioma. Methods range from dynamical systems to optimal control. Another well represented topic of this volume is mathematical modeling in epidemiology. Mathematical approaches to modeling and control of more specific diseases like malaria, Ebola or human papillomavirus are discussed as well as a more general approaches to the SEIR, and even more general class of models in epidemiology, by using the tools of optimal control and optimization. The volume also brings up challenges in mathematical modeling of other diseases such as tuberculosis. Partial differential equations combined with numerical approaches are becoming important tools in modeling not only tumor growth and treatment, but also other diseases, such as fibrosis of the liver, and atherosclerosis and its associated blood flow dynamics, and our volume presents a state of the art approach on these topics. Understanding mathematics behind the cell motion, appearance of the special patterns in various cell populations, and age structured mutations are among topics addressed inour volume. A spatio-temporal models of synthetic genetic oscillators brings the analysis to the gene level which is the focus of much of current biological research. Mathematics can help biologists to explain the collective behavior of bacterial, a topic that is also presented here. Finally some more across the discipline topics are being addresses, which can appear as a challenge in studying problems in systems biology on all, macro, meso and micro levels. They include numerical approaches to stochastic wave equation arising in modeling Brownian motion, discrete velocity models, many particle approximations as well as very important aspect on the connection between discrete measurement and the construction of the models for various phenomena, particularly the one involving delays.

With the variety of biological topics and their mathematical approaches we very much hope that the reader of the Mathematical Biosciences and Engineering will find this volume interesting and inspirational for their own research.

Guest Editors:
Avner Friedman, Mirosław Lachowicz, Urszula Ledzewicz
Monika Joanna Piotrowska and Zuzanna Szymanska