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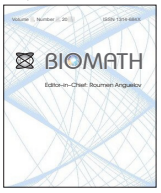

The Art of Mathematical Biology: a Foreword for the Launch of BIOMATH

We cannot debate that the advances made over the past 30 years in molecular biology, biochemistry and cell biology have dramatically changed biology and the biomedical sciences. Academic institutions and funding agencies increasingly recognize the interdisciplinary nature of biology and medicine, including the important role mathematical, statistical and computational modeling play in the analysis and interpretation of data and information.

By and large, biologists and biomedical scientists appear to have more appreciation for mathematical biology research because they are increasingly attracted to discover new biological principles and mechanisms in collaboration with mathematicians.

As a biomedical scientist active in the field of mathematical biology, I believe that the scope of mathematical biology includes providing novel biological insights that come from the mathematical formulation and analysis of biological problems. I fully recognized, however, that mathematical biology can also stimulate the development of new mathematics.

There are excellent examples in the literature of mathematical biology research that have provided novel and important biological insights. Classical examples may be found in the work of Alan Turing [1] and of Alan Hodgkin and Andrew Huxley [2]. Much has changed since the publication of these papers. A mathematical biology research project is no longer guided by the independent spirit of one or two applied mathematicians working on a biological problem. Modern examples show that mathematical biology research is now a team science effort. How do we presently perform mathematical biology research? An answer can be given by dividing the research process into the three steps of performing applied mathematics research [3].

The first step in performing mathematical biology research requires the formulation of the biological problem in mathematical terms. There is a widespread misunderstanding that this requires a proficiency and encyclopedic knowledge of biology. In reality it requires a good biological intuition and insight into the decision of which biological problems to attack. We need to learn to exercise excellent judgment in the formulation of the problem. This entails deciding what approximations to adopt in order to achieve a minimal model. The derivation of a minimal model, without losing the essential mechanisms of the problem, is an art form rather than a science. The mathematical biologist cannot master this art by working independently and as an isolated scientist. Biology is so complex that the knowledge, intuitions and insights now require interdisciplinary team work.

The second step in performing mathematical biology research requires the solution of the mathematical model formulated. In mathematical biology, this now requires an extensive knowledge of mathematical, computational and statistical methods. The selection of the appropriate mathematical or computational technique will depend on the biological and physicochemical scales of the problem under consideration. The solution of most of the mathematical models requires the implementation of complex computational algorithms. Mathematical biologists need to investigate the model dynamics under biologically realistic parameter bounds. At the same time mathematical biologists need to investigate model sensitivity to parameters and initial conditions using statistical approaches and sensitivity analysis. Knowledge of mathematics, scientific computing and statistics is obviously necessary, but there is no person with an encyclopedic understanding of these methods. The isolated mathematician again will have

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limited chances of succeeding.

The third step in performing mathematical biology research requires the interpretation of the mathematical model solutions and their empirical verification in experimental terms. This step serves as the culmination of the research, but it cannot be accomplished without the interdependence between the mathematical biologists and the experimentalists. Although it would be incorrect to say that all mathematical biology involves this third step (for example, the development of new mathematics and theory may not include this step), mathematical biology research must give priority of the empirical verification and evidence. Novel mathematical biology ideas, methods and techniques will need to show usefulness in the biological and biomedical sciences.

In the context of the International Conferences on Mathematical Methods and Models in the Bioscience (BIOMATH 2011 and BIOMATH 2012), held in Sofia, Bulgaria, it is a great pleasure to see the steps of mathematical biology research effectively applied to investigate a wide range of problems in the biological and biomedical sciences. The BIOMATH conferences will serve to train and catalyze new research avenues for young scientists in Bulgaria, Eastern Europe and elsewhere.

Mathematical biologists are now actively seeking collaboration with experimental biologists and the need for real application is being emphasized in mathematical biology research. There are tremendous opportunities for the new generation of mathematical biologists in interdisciplinary research.

The Bulgarian Academy of Sciences is undertaking an exciting challenge with the new journal BIOMATH. They are launching BIOMATH to publish research being undertaken in the growing field of mathematical and computational biology. BIOMATH will strive to be a leader in the field, publishing new research articles, reviews and communications. The editorial team composed by Roumen Anguelov (University of Pretoria, South Africa), Svetoslav Markov (Bulgarian Academy of Sciences) and Nina Pesheva (Bulgarian Academy of Sciences) intends to appeal to a broad audience of researchers who draw on mathematics, statistics and computing, with the aim of providing insight into the life sciences. The Bulgarian Academy of Sciences and editorial team are launching BIOMATH with the determination to make it a success.

I sincerely hope that you and your colleagues will enjoy reading the articles in this new journal and will submit your work for publication in BIOMATH.

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