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NEW HOT PAPERS - 2009

September 2009

PDF

Nicola Bellomo, Philip K. Maini & Natasha Li Martin talk with *ScienceWatch.com* and answer a few questions about this month's New Hot Paper in the field of Mathematics.

Article Title: On the foundations of cancer modelling: Selected topics, speculations, and perspectives
Authors: Bellomo, N;Li, NK;Maini, PK
Journal: MATH MODEL METHOD APPL SCI, Volume: 18, Issue: 4, Page: 593-646, Year: APR 2008
* Politecn Turin, Dept Math, Corso Duca Abruzzi 24, I-10129 Turin, Italy.
* Politecn Turin, Dept Math, I-10129 Turin, Italy.
* Math Inst, Ctr Math Biol, Oxford OX1 3LB, England.
* Oxford Ctr Integrat Syst Biol, Dept Biochem, Oxford OX1 3QU, England.

SW: Why do you think your paper is highly cited?

It is becoming increasingly recognized that mathematical modelling may have an important role to play in many biological systems. In the context of disease, understanding cancer and developing treatment strategies is obviously of great importance.

Mathematical modelling in this area has grown immensely as we strive to develop a framework in which to interpret the enormous amount of experimental data being generated. New mathematical methods have been developed to capture aspects of the complexity of living matter, but many important challenges lie ahead.

Indeed, the scientific community is becoming increasingly aware that the great revolution of this century is going to be the mathematical formalization of phenomena in the life sciences, much as the revolution of the past two centuries was the development of the same approach in the physical sciences.

SW: Does it describe a new discovery, methodology, or synthesis of knowledge?

This paper presents a review and critical analysis of some selected issues related to the mathematical approach to the modelling of phenomena in cancer, with the goal of introducing the technical challenges to a broad range of applied mathematicians, armed with a wide variety of skills.

Particular attention is drawn to the multiscale aspects of the problem and of the related mathematical approaches; strategies to select the correct mathematical framework to deal with modelling at each scale; looking for paradigms for the development of a mathematical biological theory related to the complex system under consideration.

SW: Would you summarize the significance of your paper in layman's terms?

The aim of mathematics is to do for the life sciences what it did for physics over the past two centuries. This paper extensively reviews the relevant literature and sets out the mathematical problems that need to be solved if we are to achieve this aim. It contains a preliminary attempt to devise a biological mathematical theory.

Coauthor:
Philip K. Maini

Coauthor:
Natasha Li Martin

SW: How did you become involved in this research, and were there any problems along the way?

The two senior authors have been involved in two consecutive large European projects focused on the modelling of cancer phenomena and related therapeutical actions. These projects, both directed by one of us, have encouraged many more mathematicians from across Europe to move into this field.

Natasha Li Martin, at the time a Ph.D. student in Oxford, brought a great deal of energy and enthusiasm, which was necessary for analyzing the 200 titles that have been reviewed in this paper.

SW: Where do you see your research leading in the future?

Until now, cancer has been studied in terms of cellular growth, while recent experimental research has increasingly focused on the crucial underlying genetic and subcellular processes involved in tumor initiation.

The modelling approach must span the spatial scales, from genetic mutation to tissue invasion, and must consider its dynamics in the context of an ecological situation in which the population of tumor cells is in competition with normal cells and the immune system.

SW: Do you foresee any social or political implications for your research?

It is clear that developing successful strategies for treating cancer will have a huge impact on human health. Modelling and simulation of tumor growth can play an important role in this.

It is true that mathematics alone cannot solve the problem of cancer. However, applied mathematics may be able to provide a framework in which experimental results can be interpreted, and a quantitative analysis of external actions to control neoplastic growth can be developed.

Specifically, models and simulations can reduce the amount of experimentation necessary for drug and therapy development. Moreover, the mathematical theory developed might not only provide a detailed description of the spatiotemporal evolution of the system, but also may help us understand and manipulate aspects of the process that are difficult to access experimentally.

Nicola Bellomo, Ph.D.
Professor of Mathematical Physics and Applied Mathematics
Department of Mathematics
Facoltà di Ingegneria
Politecnico di Torino
Torino, Italy
Web

Philip K. Maini, Ph.D.
Professor
Centre for Mathematical Biology
Mathematical Institute
University of Oxford
Oxford, UK
Web

Natasha Li Martin
Postdoctoral Researcher
Department of Social Medicine
University of Bristol
Bristol, UK

Web

KEYWORDS: CANCER MODELLING; MULTISCALE MODELLING; COMPLEXITY IN BIOLOGY; LIVING SYSTEMS.

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