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Competition for the academic position "Associate Professor"
announced by the Institute of Mathematics and Informatics
at the Bulgarian Academy of Sciences
State Newspaper No. 14 of 10.02.2023
Field of Higher Education:4. Natural sciences, mathematics and informatics
Professional Field: 4.5 Mathematical modeling and Applied Mathematics
(Mathematical Biology)

Dear Colleagues,

It is a pleasure to help evaluate Dr. Milen Borisov for the position of Associate Professor at the Institute of Mathematics and Informatics (IMI), Bulgarian Academy of Sciences (BAS). I have met Dr. Milen Borisov professionally about 7 years ago and I am aware of his work both from the research literature and from conference presentations. My own research interests are in the field of chemical reaction networks models and more broadly applied mathematics, so they overlap with Dr. Borisov's research.

General description of the scientific papers.

Dr. Borisov has presented 11 papers for evaluation for the position of an associate professor. The papers have not been used in previous promotions. Seven of the works are published in journals with impact factors and cited in Web of Science; another three articles are cited and reviewed in MathSciNet and Zentralblatt. Based on the presented works classification, Dr. Borisov completes the NACID requirements for associated professor. The submitted for evaluation papers have 50 citations, with 32 of them in Web of Science and Scopus.

Scientific research and main contributions.

Dr. Borisov's research has been focused on the theory of bioreactors and chemical reaction networks, and since recently mathematical epidemiology as part of mathematical biology. He has developed theoretical models with time delays for analyzing of bioreactors related to waste water treatment, methane and hydrogen production, as well as fermentation processes. His other research interests are in the field of mathematical epidemiology, where he has developed and analyzed new types of epidemiology models applicable to both communicative and non-communicative diseases.

Below, I will discuss only some of the research work that I am most familiar with presented by Dr. Borisov in his dossier. It is very important to note that all of his papers are peer-reviewed and have been published in high-quality applied mathematics and interdisciplinary journals.

Bioreactors models have many diverse applications. In Dr. Borisov's work they are used to understand the work of waste water plants as well as to optimize methane and hydrogen production. The standard models are in the form of ordinary differential equations systems; Dr. Borisov with his collaborators consider also time delay models that are significantly more difficult to analyze. In all such publications, apart from the stability analysis, numerical simulations with the help of the software *SmoWeb* developed by Dr. Borisov are performed. The proposed algorithms for governing chemical process in bioreactors aim at maximizing flow rates.

Reaction network theory (RNT) is used to model (bio)chemical reaction networks mathematically in order to analyze their biochemical properties. It is a relative novelty to use RNT in order to analyze growth models which are often used in modeling various processes in ecology, demography, or social sciences. The analysis of such growth models recasted as reaction networks models leads to a better understanding of their properties. Dr. Borisov's contribution concerns the Gompertz model and a "Gompertz-type" growth models which are studied in two papers. In another paper, submitted by Dr. Borisov, the SIR (susceptible-infected-recovered) model is analyzed from the perspective of RNT, as well as from epidemiological modeling point of view. A new epidemiological model is suggested which is more suitable as an intermediate step between the SIR and models used to analyze non-communicable diseases.

Scientific Projects.

I have concentrated mostly on Dr. Borisov's research as I am more familiar with it. I would like to mention also, that he has successfully obtained and participated in some highly selective grants awarded by BAS and the National Science Fund. Such grants are awarded only to a few researchers each year and give great opportunities for interdisciplinary collaborations and broadening one's research horizon. I am confident that Dr. Borisov will continue to seek external grants actively after his promotion.

Dr. Borisov often incorporates the use of technology such as *Maple, Matlab* or *Python* into his research. He is the developer of a user-friendly, web-based software *SmoWeb* which can be used for numerical simulations of life-sciences mathematical models. The package *Biochemical reactions* developed by Dr. Borisov for the analysis and visualization of ODE systems' dynamics can be specifically used to model reaction networks. In fact, *Biochemical reactions* has been extensively used to suggest, confirm

or illustrate the validity of the theoretical results in many of the papers of which Dr. Borisov is a co-author and a main contributor.

Teaching and service record.

Dr. Borisov's service record shows that he is actively involved with IMI and BAS. He also services the mathematical community as a whole by actively participating in organizing mathematical biology conferences such as the annual BIOMATH conference or refereeing for many mathematical biology or applied mathematics journals. Dr. Borisov has some teaching experience according to his CV. He is engaged in teaching tutorials for the Mathematical Modeling in Biology course at the Department of Mathematics at Sofia University.

Conclusion.

In conclusion, Dr. Borisov is an active member of his department and IMI who has shown significant research accomplishments. I am confident that his strong performance as a scholar will continue. Based on Dr. Borisov's research achievements and service record I strongly recommend Dr. Borisov be promoted to associate professor.

Sincerely yours,

Maya Mincheva