OPPONENT REVIEW

Competition for holding of academic position "Associate Professor", gazetted on 15 March 2022, No 21

One candidate: Ivan Georgiev Hristov

Procedure Notifier: Dept of Computer Informaticshematics and Statistics, Faculty of Mathematics and Informatics by the St. Kliment Ohridski University of Sofia

Professional Direction: 4.6 Informatics and Computer Science

Scientific Subject: Programming

Opponent: Prof. Michail Todorov, PhD, Dept of Mathematical Modeling and Numerical Methods, Faculty of Applied Mathematics and Informatics by the Technical University of Sofia, Bulgaria, by order РД-38-232/11.05.2022 of the Rector of St.Kliment Ohridski University of Sofia

1. Short biographical record of the applicant

Dr Ivan Hristov was born in 1977. He undergraduated Faculty of Mathematics and Informatics by Sofia University, subject applied mathematics in 2004 and three years later in 2007 he graduated the same university, subject Computational Mathematics. Since 2007 he has been Assistant Professor in Department of Numerical Methods and Algorithms and Computer Informatics (2018). In 2011 Dr Hristov occupies the position of Senior Assistant Professor. In the period 2014-2017 he realizes two 14-months specializations in LIT, JINR in Dubna, Russia. Mean-while he took his PhD degree in Mathematical Modeling and Math Applications in 2014, thesis title "Numerical Investigation of Static Modes in Josephson Junctions."

2. General description of the competition documents

I checked up the SU Regulations and assured that the applicant filled the compulsory documents, including CV, PhD diploma, document for academic position, information about minimal national requirements (NCID), 2 lists of citations, author information for the scientific contributions related to the given competition supplied by PDF copies of all the articles, list of research competitions, abstracts of refereed publications following the Authors system.

3. General characterization of the research, teaching and applied activities

The results are presented in complement conferences in BG and abroad. The total scientific contribution of Dr Hristov consists of 37 works including 10 articles in collections, 22 in conference proceeedings and 5 journal papers the more of them possess SJR and one belongs to the quartile Q3. The works are co-authored – two and more co-authors. The applicant does not present a confirmation for equivalent co-authorship and this is the reason to suppose that his

participation is at least of equal value. The applicant presents a citation reference containing 7 cites in the period 2014-2021 all of them SJR indexed.
The applicant presents 12 papers for the competition 4 of them are habilitation work. All the papers are SJR indexed. They are published in *CEUR Workshop Proceedings, EPJ, Studies in Computational Intelligence (Springer), AIP CP*, *Lecture Notes in Computational Science* in the period 2014-2021, i.e. they are not included in any previous competitions. The journal works are published in *Transport Problems* and *TEM Journal.* The proceedings works are in AIP CP and IOP. More details can be seen in the following

Table: Information about the works

	Abroad
Works – 5+10+22 numbers	*CEUR Workshop -4 numbers., EPJ - 1 number, American Institute of Physics Conference Proceedings –4 numbers, Springer – 3 numbers*
Reports on national and international scientific events > 10.	*AMiTaNS –4 times, BG SIAM – 3 times, etc.*

Dr Hristov has taken part in 15 projects granted by the National Science Foundation and guided 5 of them. He realized two short-term (14-months) specialization in LIT, JINR – Dubna and as a complement of abovementioned projects he actively takes part in two bilateral projects between FMI and JINR. His activity results in one awarded graduated student. Since 2018 the applicant reads classes in FMI Introduction in the Programming and Data Structures.

Having in mind the said above and according with the Regulations in the Faculty of Mathematics and Informatics I can conclude that the applicant covers the requirements to hold the academic position of Associate Professor in the professional subject 4.6 Informatics and Computer Science. Also, he covers and exceeds the minimal national regulations of LDASRB and has not any plagiarism in his works.

4. Analysis of the scientific and applied contributions

Dr Hristov presents comprehensive author information where he claims his scientific and applied contributions. His works can be grouped in 2 parts: Parallel Computing and Numerical Investigation of Josephson Junctions.

- *Parallel Computing*

This topic covers works [1] to [6] from the competition list.

In work [1] is realized an approach for OpenMP parallelization of Taylor Method with variable step with respect to coupled Lorenz systems. A reliable solution in long time interval is

obtained. Similarly in work [2] is developed efficient MPI + OpenMP parallelization of the same method for the classical Lorenz system. For a given level of accuracy the optimal variable step specifies higher order of accuracy compared to an optimal fixed step. The conclusion reads that the variable step used for the classical Lorenz system decreases the computational resources as well as increases the parallel efficiency compared to a fixed step. In work [3] is considered a simulation of standing waves in natural Josephson junctions solving a system of perturbed 2D Sine-Gordon equations. In work [4] is implemented an OpenMP program that uses two parallel levels both to fibres and SIMD. A hybrid MPI+OpenMP program is coded to solve numerically system of perturbed 2D Sine-Gordon equations by using of leapfrog difference scheme. The experiments are conducted on CPU platform in the cluster placed in IICT-BAS. Further, in work [5] is accomplished parallel OpenMP program for numerical treatment of a system of perturbed 2D Sine-Gordon equations by using a leapfrog difference scheme. The parallel OpenMP program is realized again on the computational cluster in IICT, BAS. For given parameters a standing wave is observed. In work [6] is investigated numerically a class of combined explicit-implicit Taylor methods with different accuracy applied to Hamiltonian systems. The numerical implementations demonstrate that the realized methods behave as symplectic in energy conservation and in some cases they can exceed the standard Verlet method of order two.

- *Numerical Simulations of Static and Dynamical Modes in Josephson Junctions*

This topic covers the works [7]-[12] from the competition list. In particular, in work [7] is developed a difference scheme of perturbed Sine-Gordon equations with fixed parameters and trivial or random initial conditions. It is demonstrated numerically that the phase state is the natural state of Josephson junctions for given values of both the outer magnetic field and currency. In work [8] is studied again numerically the dynamics of multilayer Josephson junctions in frame of the Machida-Sakai generalized model. The influence of the capacity interaction upon the fluxon dynamics is analyzed and compared with the case of pure inductive interaction. The corresponding system of perturbed Sine-Gordon equations is solved numerically by using of finite difference method. In work [9] is investigated the dynamics of fluxon lattice in stacks of Josephson junctions when the outer magnetic field varies. The latter covers a system of perturbed Sine-Gordon equations and computing the relationship magnetic field – resistance of the obtained solutions. To solve the mixed initial-boundary value problem again is used the finite difference method. In work [10] the Sakai-Bodin-Pedersen model (a system of perturbed Sine-Gordon equations) is used to solve numerically the dynamics of stack phases in long Josephson junctions. The boundary conditions correspond to in-line geometry. In order to get appropriate initial values for the dynamic problem one needs preliminary to solve the static problem. In work [11] the above method is used to solve numerically a system of three perturbed Sine-Gordon equations. Efficient numerical algorithms for studying the transitions from static to dynamic state in stack of three Josephson junctions are implemented. At last in work [12] is investigated the stability of possible sgtatic solutions – kind of Sturm-Liouville problem. The transitions from static do dynamical state depending on the parameters are analyzed. Various physical

characteristics are computed and interpret – volt-ampere, tensions and inner magnetic fields in the individual junctions.

The main contribution of Dr Hristov consist in the program coding of algorithms and methods as well as the analysis and interpretation of the obtained results. Let me emphasize the results can classified to both directions 4.6 and 4.5. To study Josephson effect exceeds the programming and numerical simulations – it requires profound knowledge on physics of superconductors, spectral methods and nonlinear phenomena. I know the applicant long time ago and assert with confidence he possesses the experience and qualification to accomplish them.

5. Importance and contribution to the science and practice. Citations by other authors

In my opinion, the works of the applicant indicate the achievements and accents in his scientific production. The conducted investigations and publications possess mainly applied significance. Undoubtedly Dr Hristov holds and can apply effectively the information technologies, which he complements by profound information knowledge and experience so needed for the successful mathematical research. The results obtained got publicity and recognition in BG. In order to become internationally known the applicant and his collaborators definitely need to increase their publication activity abroad including high-ranked journals. I think the significance of the considered problems as well as the obtained results presuppose that.

6. Critical remarks and recommendations

I have not any remarks and criticisms. The documents give a real imagination about the scientific activity of the applicant. The statement demonstrates a deep understanding of the studied matter the latter being hard for numerical and analytic study as well as for experimental prediction and confirmation. The reference to the regulations for holding of academic positions demonstrate explicitly that Dr Hristov covers the minimal scientific criteria for associate professor in natural sciences: Group A – 50 points, required 50 points; Group B – 120 points, required 100 points; Group Г – 240 points, required 200; Group Д - 56 points, required 50 points; group E – 120 points. The works are published in journals with SJR. The number of citations is 7. In my opinion, the applicant is well qualified and inspired to carry out further investigations on programming of numerical methods and algorithms to apply them for solving of relevant problems. The applicant possesses the resource and capacity to implement that. Yet, the gained level of knowledge requires Dr Hristov to keep developed this research topic attracting graduate and postgraduated students to train.

7. Personal impression

I have known Ivan Georgiev long time ago – more then 10 years. He attended and took part in the annual event AMiTaNS few times. In 2014 I was involved to be opponent of his PhD thesis and took part in his defence. He strikes me as a modest but exact and efficient young professional, who enthusiasticly and permanently strives for mastering of new matters.

Conclusion

Gaining an impression for the all-round scientific and research activity of the applicant and having in mind the legal national rules and criteria (LDASRB) as well as the specific rules in FMI, SU I **rate positively** the entire activity. On the strength of virtue of the law **I propose Dr Ivan Georgiev Hristov** for academic position Associate Professor in the Faculty of Mathematics and Informatics by the St. Kliment Ohridski University of Sofia, Professional Direction 4.5 Informatics and Computer Science, Scientific Subject: Programming.

Opponent

(Prof. Michail Todorov)

Sofia-Albena, June 27th 2022