

Referee report

for the academic position of "Professor" in the professional field 4.5. Mathematics, major in Mathematical Modeling and Application of Mathematics (Monte Carlo and Quasi-Monte Carlo Algorithms and Applications), published in State newspaper, no. 41 of May 21, 2019; the position for the Department of Grid Technologies and Applications section (new name: "High Performance Systems, Networks and Algorithms" with the sole candidate, namely, Assoc. Prof. Dr. Emanuel Yordanov Atanasov

Reviewer: Prof. Ivan Tomov Dimov - Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences

The following documents were submitted to the reviewer:

1. European CV.
2. A copy of the diploma of the doctoral degree.
3. Certificate of internship in the specialty.
4. List of scientific publications of the applicant.
5. List of citations.
6. Abstracts of the scientific publications for participation in the competition - in Bulgarian.
7. Abstracts of the scientific publications for participation in the competition - English.
8. Reference for meeting the minimum requirements of ICT.
9. Reference for original scientific and applied scientific contributions.
10. Declaration that the applicant has not been duly proven plagiarized in scientific works.
11. List of national and international projects of Assoc. Prof. Dr. Emanuel Yordanov Atanasov, IICT-BAS.
12. Copies of all scientific publications for the competition.

1. General characteristics of the scientific results

The candidate Assoc. Prof. Dr. Emanuil Yordanov Atanasov participates in the competition for professor with publications, the list of which includes 14 scientific papers. Of the 14 publications submitted for the competition, I do not consider dealing with the number [17] as I am a co-author of the candidate in this publication.

The numbering of the candidate's articles is in accordance with the general list of publications, which consists of 21 publications. All the works submitted for the competition were not used

in the selection of Emanuel Yordanov Atanasov for associate professor (Ph.D. II.). The submissions for the competition cover various aspects of computational mathematics, all of which have been published in SJR and / or ISI Impact Factor journals. Selected are articles from the period after the competition for associate professor until 2015-2016. The scientific and applied contributions submitted to the competition have received recognition, as evidenced by the citations provided, which are exclusively derived from the Scopus database.

The applicant's documents documented 46 citations of 10 of his work in Scopus / WoS from 2007 to 2015. This data indicates a good international recognition of the applicant.

In this sense, the scientific problems considered and the problems solved by him in the scientific publications presented are within the professional field 4.5. Mathematics, specialty "Mathematical modeling and application of mathematics (Monte Carlo and quasi-Monte Carlo algorithms and applications)".

2. Contributions contained in submitted works for review

The obtained results can be characterized as development, investigation and parallel implementation on modern computing systems of new Monte Carlo quasi-Monte Carlo methods and algorithms.

The results can be structured in the following directions:

1. Development, software implementation and study of classes of algorithms using fine levels of concurrency and heterogeneous computing systems.
2. Optimization of high performance calculations for modeling and application purposes.
3. Algorithms for efficient generation of low discrepancy series.
4. Creating services for efficient use of distributed computing environments.

The first scientific area "Design, Software Implementation and Study of Classes of Algorithms Using Fine Levels of Parallelism and Heterogeneous Computing Systems" has developed and tested algorithms using fine-grain parallelism suitable for use on modern heterogeneous computing systems.

A new software library for genetic algorithms has been implemented, capable of using heterogeneous computational resources of different types, with optimized organization of communication between different processes. The scalability of the library has been tested on Grid [12] and supercomputer systems [19], and in both cases high parallel efficiency has been demonstrated. Various parallel programming techniques are used, OpenMP and MPI has been tested and OMPSS.

Algorithms have been developed using GPGPU resources for cryptographic calculations related to the security of modern communication protocols. These algorithms have been tested on GPGPU computing servers available in our country. The performance of NVIDIA product cards is compared with typical gaming cards adapted for this kind of calculation [18]. Effective

algorithms for multiplication of specific sparse matrices have been developed, which, with practical implementation on Xeon Phi accelerators, demonstrate high efficiency [2].

In the second scientific area, a Monte Carlo algorithm for the modeling of quantum phenomena (the so-called super-fast Wigner transport) arising in quantum wires has been developed. Despite the natural parallelism of this type of algorithm, the dispersion becomes significant over relatively long periods of time, which justifies the need to use high-performance computations to achieve the desired accuracy [3].

In [5], the conformations of CD38 and the inclusion indices of some small and large ring cyclodextrins were investigated. For this purpose, an application used in computational chemistry was optimized on the currently available high performance cluster with infiniband bond. Methods and metrics have been developed to evaluate the energy efficiency of algorithms using heterogeneous computing systems. Not only the use of electricity was reflected, but also the cost of acquiring the system, resulting in a more accurate metric, which aids the choice of algorithmic implementation [7, 8, 9].

The major contributions to the third scientific area, "Algorithms for Effective Generation of Low Discrepancy Rows", include the study and creation of algorithms for the generation of low discrepancy series. It is important to note the candidate's achievements in defining modified Holton series that have certain theoretical advantages and therefore have a strong interest in the Monte Carlo College. When accelerators are used, the trivial transfer of code written to the CPU in the middle of the accelerators results in poorly performing code.

The Emanuel-developed generators use the features of the respective accelerator type and programming environment to obtain adequate performance. This is a relatively technical work, however, leading to a significant improvement in efficiency. It is important to note that scrambling is included, which has proven benefits such as convergence rate (Owen scrambling) and in terms of obtaining a posteriori error estimation for quasi-Monte Carlo algorithms. The Sobol series are discussed in [15] and found application in [11, 21], while the methods for Holton series and their modifications are discussed in [20].

I would like to point out here that the applicant has made many serious contributions to the development of services and schemes for the efficient use of distributed computing environments, such as Grid and Cloud.

3. Publications and citations of publications participating in the competition.

The relevance and importance of scientific and applied contributions are indisputable. They follow from the fact that the majority of publications are in reputable specialized publications with an impact factor.

Emanuel Atanasov has documented 46 citations to 10 of his work in Scopus / WoS from 2007 to 2015. Of the publications submitted for the competition, none are independent, but in this field it is natural to work in teams. At the same time, there is no doubt about the candidate's personal involvement. In each of the collaborations, the applicant makes the necessary

substantial contribution. Nevertheless, in the future, I recommend that the applicant also publish freelance work.

4. Educational activity and participation in projects.

Assoc. Prof. Emanuil Atanasov did not provide evidence with official documents on university courses, but I know that he has taken such courses. He has taken a Matlab course at FMI and is currently taking a Grid course at the BAS Training Center. There is also participation in the preparation of doctoral students. There are also two graduates from the Sofia University and two doctoral students who have completed their doctoral studies with a law degree. He has successfully participated in a number of national and international scientific projects. In four of the projects he has worked on, he has been managing, one of which is international under Horizon 2020, and three are national and funded by the Bulgarian NSF. Participates in 8 international scientific or educational projects and 6 national scientific projects. He has been the leader of the Bulgarian team in 5 international scientific projects.

5. Notes and Recommendations.

I have no particular remarks and recommendations for Emanuel Atanasov. I recommend that the candidate should prepare documents more carefully and accurately for the competitions he takes part in.

CONCLUSION. Based on the aforementioned, it is clear that the candidate for the announced competition Assoc. Prof. Dr. Emanuil Yordanov Atanasov fully complies with the requirements of the ZRASRB, the Rules for the application of the ZRASRB, the Rules for the conditions and procedure for acquiring academic degrees and for occupying academic positions in the Bulgarian Academy of Sciences, as well as the Rules for the Specific Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences. The scientific results achieved give me reason to propose the selection of the candidate Assoc. Prof. Dr. Emanuil Yordanov Atanasov as a professor at IICT-BAS in the professional field 4.5. Mathematics, major in Mathematical Modeling and Application of Mathematics (Monte Carlo and Quasi-Monte Carlo Algorithms and Applications), published in State Newspaper no. 41 of May 21, 2019, for the needs of the Grid Technologies and Applications section (new name: "High Performance Systems, Networks and Algorithms"). Therefore, my conclusion is to occupy the academic position "Professor" announced by Assoc. Emanuil Yordanov Atanasov is POSITIVE.

09/13/2019

Sofia

Signature:

**NOT FOR
PUBLIC RELEASE**

/ Prof. Ivan Dimov /