

## OPPONENT REVIEW

Competition for holding of academic position “Professor”, gazetted on 15 March 2022, No 21

**One candidate:** Stanislav Nikolaev Harizanov

**Procedure Notifier:** Institute of Information and Communication Technologies, BAS - Sofia

**Professional Direction:** 4.5 Mathematics

**Scientific Subject:** Computational Mathematics

**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 132/13.05.2022 of the Director of Institute of Information and Communication Technologies, BAS - Sofia

### 1. Short biographical record of the applicant

Stanislav Harizanov was born in 1983. He graduated the Faculty of Mathematics and Informatics by the St. Kliment Ohridski University of Sofia in 2005, subject Mathematics. He continued his education in Jacobs University in Bremen where got graduate degree in 2008, and PhD degree in 2011, subject “Analysis of nonlinear subdividing operators and their multiscale transformations”. During the next two years he occupies a post-doc position in the University of Kaiserslautern and specializes image processing. Since 2014 Stanislav Harizanov has been Assistant Professor in IICT (2014) and IMI (2016), Senior Assistant Professor (2016 in IICT) and (2017 IMI) in sections “Scientific Computing” and Mathematical Modeling and Numerical Analysis”. In 2018 he is nominated and chosen to be Associate Professor both in IMI and IICT. Since then Stanislav has conducted elective course in FMI “Convex analysis and its application to image processing”.

### 2. General description of the competition documents

The applicant filled following compulsory documents: CV, copies of Assoc. Professor and PhD diplomas, information about minimal national requirements (NCID) and specific IICT requirements, certificate for a length of service, list of citations, author information for the scientific contributions related to the given competition supplied by PDF copies of all the articles in Bulgarian and English, list of research competitions and projects, abstracts of refereed publications, declaration about a non-plagiarism.

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

The results are presented in complement conferences and seminars in BG and abroad. Though Assoc.Prof. Harizanov does not announce his general scientific production, we can conclude after the citation reference theta four works are cited many times: *Numer Linear*

*Algebra Appl.* (2018) и *Legal Medicine* (2018) are cited 19 and 10 times, respectively. The total number of independent cites is 40 all of them in reviewed issues and journals with impact factor and/or SJR.

The applicant presents 17 works for the competition including 15 journal papers, 5 of them belong to quartile *Q1* and 1 - to *Q3*, 1 chapter and the else 9 – in the proceedings of *Springer, AIP, BG SIAM, John Wiley*. The total IF is about 16.5. All of them are published in the period 2019-2021, i.e., they are not included in any previous competitions. The journal works are published in high ranked issues (*Computers and Applications with Application, Mathematics & Computers in Simulation, Concurrency and Computation: Practice and Experience, Fraction and Fractals, etc.*) The proceedings works are mainly in Springer. Assoc.Prof. Harizanov does not present self-dependent works. All of works are with two or more co-authors. In 9 of them he is a first author. 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. More details can be seen in the following

**Table:** Information about the works

Works – 6+9+2 numbers	Abroad <i>Computers &amp; Mathematics with Application - 1, , Mathematics &amp; Computers in Simulation – 2, Concurrency and Computation: Practice and Experience – 1., Lecture Notes of Computer Science –3, American Institute of Physics Conference Proceedings –2, etc.</i>
Reports on national and inter-national scientific events > 25.	<i>Large-Scale Scientific Computing – 8 times, AMEE – 1 time, AMiTaNS – 2 times, ICIMMI 2020 – 1time, 30th Chemnitz Finite Element Symposium – 1 time</i>

The applicant actively takes part in numerous national and international research projects. Among them 10 in IMI-BAS granted by program Horizon 2020 and Education for Science under Bulgarian NSF where he is participant, coordinator or leader. His activity and efficiency in IICT-BAS are also remarkable – 8 grants under Bulgarian NSF, 1 under program Horizon 2020, 1 with the European Community, and 1 under 7th FP. After the documents one concludes that the applicant does not teach nor train students. However, he is engaged in the training of student's teams for math competitions and Olympiads where his traineds gained prestigious prizes. Since 2019 Assoc. Prof. Harizanov has been the leader of national student's team on math. In the last year he was nominated to be Chairman of the National Commission by Bulgarian MES, organizing the student's math Olympiad.

Having in mind the said above and according the Regulations in BAS and in particular those in the Institute of Information and Communication Technologies I can conclude that the applicant covers the requirements to hold the academic position of Professor in the professional

subject 4.5 Mathematics. 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 Harizanov presents comprehensive author information where he claims his scientific and applied contributions. The investigations are directed to the computational mathematics, functional analysis, theory of approximations, algorithms, efficiency analysis and optimization as well as various applications of mathematics. The problems into consideration can be grouped in 4 directions: Efficient numerical methods for solving of problems with abnormal diffusion; Almost optimal numerical algorithms for solving of big problems with abnormal diffusion; Applications of mathematics in biology; Process optimization. Below we consider briefly each one of them.

- *Efficient numerical methods for solving of problems with abnormal diffusion*

The works [1,2,5,7,14] from the author list belong to this topic. New quasi-optimal methods and algorithms for solving of problems with fractional diffusion operator and homogeneous Dirichlet conditions are developed. These methods are based on the element of Best Uniform Rational Approximation (BURA) of function  $t^\alpha$  in the interval  $[0,1]$ . In work [1] is implemented thorough theoretical analysis of the approximation error as well as of the properties of the corresponding BURA element when an additional nonnegative linear term  $q \geq 0$  is present. A reverse proportional relationship between  $q$  and error magnitude is established. A generalized case when the reaction coefficient  $0 < q \leq q(x) \leq q^-$  in [14] is considered. In work [2] the homogeneous boundary conditions are of Neumann kind, while in [7] the problem is reduced to 1D model problem with nonhomogeneous Dirichlet boundary conditions. In both cases robust estimates for the error of approximation are derived. The fractional Laplacian defined by an integral presentation of the Ritz potential is investigated in work [7]. An alternative efficient method to solve the classical problem, when the BURA element is approximated is considered in work [5].

- *Almost optimal numerical algorithms for solving of big problems with abnormal diffusion*

A comprehensive analysis of the efficiency of few algorithms proposed by the author and other authors and considered in the previous topic is accomplished. In work [4] is numerically demonstrated that all of them render to 1D rational approximations at that the BURA approach turns out most effective. In work [1] is established that for large  $q$ 's and small fractional  $\alpha$ 's the derivation of the coefficients and poles in decomposition of BURA element is unstable and some two-steps URA alternatives are considered. In work [17] are documented 160 tables with the respective coefficients, zeros, extremal points of the error, decompositions of BURA and URA elements. In work [11] are analysed theoretically and empirically two other modifications of the BURA algorithm based on a truncation of the BURA decomposition like a sum or product of elementary fractions. Also, in work [11] is derived a direct theoretical relationship between the poles multiplicity subject of truncation and the condition number of stiffness matrix when the Laplacian is fractional and the boundary conditions are homogeneous of Dirichlet kind. At last, the theoretical estimates are confirmed by reliable numerical experiments in work [3].

- *Applications of mathematics in biology*

A dynamical model of the COVID-19 spread in Bulgaria in work [9] is developed. The model is grounded on the unsteady inverse SEIR model where the incubation period is constant, while the contraction and recovery coefficient is time dependent and varies. Actually work [15] is continuation of [9] taking into account the vaccination affect. In this way besides the parameters in SEIR models (contraction speed, incubation period, recovery period) the model in question contains additional parameters like mortality-rate, vaccination speed and efficiency as well as the time window needed by the organism to build antibodies. The main obstacle in the computer graphics and the analytical anthropology is the modeling of human faces with respect to a model of skull surface. At present the latter is implemented mainly by artificial convolution neuron nets applied to data bases of faces and skulls as well as through the distances between the facial and skull surfaces presented as a cloud of points. To compute the distance one uses Husdorff's metrics, that can deform the facial region. To avoid the latter in work [10] a hybrid model for computing of skull-skin distances is developed. It is grounded on semiinfinite cylinders with fixed radius  $r$  instead a ray along the normal. In this way both metrics are balanced.

- *Process optimization*

A new class of preconditioners for interface blocks needed when one solves coupled large-dimensional is considered in work [13]. The discretized inverse fractional Laplacian is replaced with its BUR analogue. It is proven that the preconditioners possess optimal computational complexity  $O(N)$  where  $N$  is the number of unknowns (freedom degrees) of the coupled discrete problem. The main theoretical contribution is the derived general estimate of the preconditioners any number of the BURA-based preconditioners. An experimental comparative analysis of the quality of parallel implementation of two algorithms for recovery of dirtied by Poisson noise images is conducted in work [8]. The results show an essential improvement when vary the sizes and the number of fibres.

An architecture of optimized solution of a building energy management is considered in work [6]. It is based on an optimal disposition of the net infrastructure inside the building. At last, in work [12] is developed a model for early location of anomalies in distributed information system by using microservice architectures. The model allows to watch in detail the net components.

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

The works of the applicant clearly indicate the achievements and accents in his scientific production. The conducted investigations possess theoretical significance giving a direction to computing algorithms, their optimization and computer implementation. Undoubtedly Dr Harizanov holds and can apply effectively the mathematical and computational methods, which he complements the knowledge so needed for the successful research. The results obtained definitely got publicity and recognition clearly seen from the impressive number of citations as well as from the journal rank where they are cited.

## 6. Critical remarks and recommendations

I have not any remarks and criticisms. The documents are prepared diligently and give a real imagination about the scientific activity of the applicant. The statement demonstrates a deep understanding of the studied matter and possesses good managing makings as well as a huge capacity of energy and enthusiasm to realize it. The reference to the regulations for holding of academic positions demonstrate explicitly that Dr Harizanov covers and exceeds the minimal scientific criteria for professor in mathematical sciences: Group A – 50 points, required 50; Group B – 120 points, required 100; Group Г – 355 points, required 260; Group Д - 240 points, required 140, group E – 383 points, required 150. The works are published in leading journals with IF and/or SJR, and are belonging to quartiles Q1 and Q3. The number of citations is sufficient – 40 in qualitative issues. In my opinion, the applicant is well qualified and can conduct specialized investigations in few directions based on his experience. This is my wish to him as well as the student's training for math competitions.

## 7. Personal impression

I have known Stanislav Harizanov long time ago. We had numerous meetings in ICT-BAS as well as during the conferences LSSC, AMiTaN, NMAA, etc. where he regularly presented scientific reports and talks and conducted scientific sessions. He strikes me as a high level professional got a dash deeply penetrated in his fields of study.

## Conclusion

Gaining an impression for the all-round scientific and research activity of the applicant and having in mind the legal rules and criteria (LDASRB and its regulations in the BAS) as well as the specific rules in ICT I **rate positively** the entire activity. On the strength of virtue of the law I **propose Assoc. Prof. Stanislav Nikolaev Harizanov** for academic position Professor in the Institute of Information and Computational Technologies, Professional Direction 4.5 Mathematics, Scientific Subject: Computational Mathematics.

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Sofia, July 10th 2022