REVIEW

**on the competition for the academic position
"Professor"
in professional field 4.6 Informatics and Computer Science, scientific field "Informatics"
(Data security, Internet of things),
at Bulgarian Academy of Sciences (BAS),
Institute of Mathematics and Informatics (IMI),
announced in State Gazette No.65/02.08.2024 and the internet site of BAS**

This review is written and submitted by Assoc. Prof. Trifon Anchev Trifonov — FMI, professional field 4.6 Informatics and Computer Science, appointed to the academic jury for this competition by the Director of IMI – BAS in accordance with Order 348/1.10.2024.

A **single candidate** has submitted an application for this competition:

- Assoc. Prof. Hristo Nikolov Kostadinov, IMI – BAS

I. General Description of the Submitted Documents:

1. Application Details

The documents submitted by the candidate are in full compliance with the requirements of the Academic Staff Development Act (ZRASRB), the Regulations Act for the Implementation of ZRASRB (PPZRASRB), and the Regulations Act about the Terms and Conditions for Acquisition of Academic Degrees and Occupation of Academic Positions at BAS (PURPNSZADBAS).

For the purposes of the competition Assoc. Prof. Hristo Nikolov Kostadinov has presented a total of 15 titles, including 15 publications in domestic and international scientific issues and conferences.

The candidate has submitted one additional document supporting the professional achievements.

The additional document is a report on the candidate's participation in research projects and a list of his graduated PhD students.

The submitted documents are structured well, which aids their evaluation.

2. Short Biographical Data

Assoc. Prof. Hristo Nikolov Kostadinov received a Master's degree in Mathematics, specialization "Coding Theory", from the Faculty of Mathematics and Informatics of Sofia University "St. Kliment Ohridski" in 2001. He studied at the University of Electro-Communications in Tokyo, from where he received his PhD in 2005. He has been working at the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences since 2005, starting as a researcher, then as a Senior Assistant Professor (2006) and an Associate Professor (2012).

Assoc. Prof. Hristo Kostadinov has been a member of eight scientific research projects, three of them international, and is currently involved in two projects on a national level. The candidate is part of the organizing committee of the Bulgarian section of the Society for Industrial and Applied Mathematics (SIAM).

3. General Evaluation of Scientific Work and Professional Achievements

The candidate's interests are in practical applications of algebra, including coding theory, signal processing, steganography, and block circuits.

Judging by the presented total list of 36 publications, Assoc. Prof. Hristo Kostadinov's research interests are in the following main areas:

- error correction codes and their applications to:
  - coded modulation;
  - steganography;
  - error detection in flash memories;
- applications of blockchains;
- Internet of Things.

A significant part of the candidate's research work is devoted to integer codes and their applications to coded modulations. The combination of these two areas is present in 21 of his papers. It is evident that Assoc. Prof. Hristo Kostadinov has been actively working in this area since the beginning of his scientific career, collaborating closely with Prof. Nikolay Manev, who is also the candidate's co-author on 28 of his papers. These are also the candidate's most cited papers with 23 citations to 8 papers out of a total of 27 citations to all 12 of the candidate's cited papers.

Two other applications of integer codes that the candidate has worked on are in steganography, which is the topic of 6 of his papers, and flash memory error detection, which is the topic of 3 of his other papers.

As of 2019, Assoc. Prof. Hristo Kostadinov is also working on several current topics together with his PhD students, including blockchains and cloud technologies.

In the text below, I will use the numbering used by the applicant in the list of publications submitted for this procedure.

The applicant's articles submitted to the competition have been selected to cover all of the above areas as follows:

- integer codes and (coded) modulations [1–4,13,14];
- blockchain applications [7–10];
- error detection in flash memories [5,12];
- Internet of Things [11,15];
- steganography [6].

I reviewed the report on the fulfillment of the minimum requirements for the academic position of "Professor" at BAS submitted by the candidate and confirm the points indicated therein, namely:

Group "A": 50 points with a minimum of 50 points for a PhD thesis;

Group "Б": 112 points with a minimum of 100 points for 5 articles in Scimago Journal Rank (SJR) journals and 1 article indexed in Zentralblatt MATH;

Group "Г": 254 points with a minimum of 220 points for 3 articles in journals with an impact factor (IF) in the first quartile (Q1), 5 articles indexed in Scopus, of which 4 with SJR and 2 without SJR;

Group "Д": 144 points with a minimum of 140 points for a total of 24 citations in Scopus on a total of 11 articles;

Group "Е": 180 points with a minimum of 150 points for one successfully defended PhD student and participation in 10 research projects, of which 3 international and 7 national.

After a detailed review of the submitted scientific publications I confirm that:

a) the sumitted publications are in full compliance with the minimal national requirements under Art. 2B (2) and (3) of ZRASRB, as well as with the additional requirements of BAS for the academic position "Professor" in the professional field of this competition;

b) none of the submitted publications have been submitted in a preceding procedure for acquiring a scientific title or an academic position;

c) there is no lawful evidence for plagiarism in the submitted publications.

4. **Analysis of the Content of the Theoretical and Applied Contributions Described in the Submitted Publications**

A total of 15 articles were submitted for the competition, including:

- 3 are in the journals *Mathematics* and *Internet of Things* with IF [12,14,15];
- 9 are in journals with SJR [2–7,10,11,13];
- 2 are in the proceedings of the conference *17th International workshop on Algebraic and Combinatorial Coding Theory* indexed in Scopus [8,9];
- 1 is in conference proceedings indexed in Zentralblatt MATH [1].

All presented papers are already published and co-authored by a group of 2 to 3 authors. The candidate has explicitly noted his own contributions only in the text of the papers [12,14,15], but after further inquiry declared that in all submitted papers his contribution is equal to his co-authors.

It should be noted that the articles submitted for this competitions in indicator groups "В" and "Г" exceed the minimum requirements for the academic position "Professor" at BAS by 12 points and 34 points, respectively, which means that the candidate would meet the requirements with only 12 of the 15 articles submitted.

The submitted citation record reports 24 citations to 11 articles. It should be noted that one of the articles, which has two citations in Scopus, numbered 19 and 20 in the reference for meeting the minimum requirements:

Avdzhieva, A., T. Balabanov, G. Evtimov, D. Kirova, H. Kostadinov, T. Tsachev, S. Zhelezova, N. Zlateva, Optimal Cutting Problem, 113th European Study Group with Industry, Problems and Final Reports, FastumPrint, Sofia, Bulgaria, 2015, pp. 49–61

is a technical report which is not included in the overall list of publications submitted by the applicant.

The results of Assoc. Prof. Hristo Kostadinov are clearly structured in the presented author's reference for scientific contributions. The candidate has proposed grouping the papers into 4 groups. In this review, we will use a slight modification of this structure to review the submitted publications.

I. **Construction of integer codes with a specific application purpose**
This group includes publications [1,5,12,14]. The contributions in them are of scientific nature, although the research is motivated by a specific applied goal. The codes constructed in the papers [1,5,12] are designed to correct a particular type of asymmetric errors that occur in multi-level flash memories. The codes constructed in the paper [14] are designed to correct for errors that occur when information is transmitted over a noisy binary channel in which the information is divided in blocks of equal length.
The papers [1] and [5] are devoted to the construction of codes correcting errors of the form $(\pm 1, 2)$. The construction is explicit, and an explicit form of the

check matrix is given. The paper [5] is essentially an extended version of [1], with both papers describing the same construction, but [5] includes a more detailed review of research in the area by other authors and presents an additional result (Theorem 1) not present in [1].

The paper [12] gives a construction generated by cyclotomic cosets, which the authors use to construct three different families of integer codes correcting errors of types $(1, 2)$, $(1, 2, 3)$ and $(\pm 1, \pm 2)$.

In [14], a construction is presented that generalizes the construction given in [12] and generated by cyclotomic cosets, and achieves correction of an error of type $(\pm 2^i)$ that can correspond to one single bit error or a combination of two single bit errors. It is claimed that the newly constructed codes produce results similar to BCH codes, but no specific experimental data is provided.

II. Triangular Quadrature Amplitude Modulation (TQAM)

This group includes the papers [2,3,4,13]. Their contributions are of scientific nature. In all these papers, the performance of a particular type of TQAM is evaluated.

The paper [2] stands out from the remaining ones in this group because it estimates the error probability of a modulation in which no codes are implemented. An exact formula for the error probability is calculated and an approximation is proposed that approximates this probability reasonably well, but has the advantage of being easier to compute.

The publications [3,4,13] present applications of integer codes to reduce the probability of error in signal transmission over a noisy channel using TQAM. For the purpose of these publications, a software tool was developed for simulation of a noisy Gaussian channel. The authors propose that the modulation points are encoded with different types of integer codes and experimentally show that this leads to a reduction, and in some cases even elimination, of errors. In [3] an application of a particular integer code for error correction in TQAM is proposed. An upper and lower bound on the error probability is estimated.

Publication [4] builds on [3] by extending one of the constructions from 16-point TQAMs over 64-point and 256-point ones. Again, an exact formula is provided to compute the error probability, but since the formula is impractical to compute, the result of applying the proposed encodings is verified empirically through experiments.

Publication [14] proposes further constructions of integer codes both for previously considered and for new TQAM schemes and again evaluates the results experimentally.

III. Steganography

Only article [6] is included in this group. Its results are of both scientific and applied nature. It explores the possibility of applying codes for watermarking of sound files so that the watermark can be reconstructed even after lossy compression. The compression is considered as a noisy channel and the codes in this case help in a better approximate recovery of the watermark. The effect of watermark addition on the quality of the corresponding music clip has also been experimentally investigated by conducting experiments with different genres of music.

IV. Blockchain applications

This group includes papers [7–10]. They are of both scientific and applied nature and are also relevant to the field of software engineering. These papers are co-authored with the candidate's PhD students.

The publications [7,8,10] focus on the so-called Software Lifecycle Management ("SLM" or "software lifecycle management") process. The authors argue that SLM processes can be automated and optimized by using blockchain technologies. The articles have a specific applied goal, but describe the solution theoretically without reporting implementation details of a software lifecycle management platform using blockchain technologies.

Each of the papers discusses common SLM problems, characterizes various blockchain technologies, and describes an idea of how these technologies might address the problems described.

In [7], properties and functionalities of blockchains that may find application in SLM are discussed. An example architecture of a prototype system that takes advantage of the functionalities in question is discussed.

In [8], examples of specific SLM processes and how such processes could be improved by blockchain capabilities are given.

Article [10] describes the same approach as given in [7], but presents more concrete diagrams describing individual SLM processes and their use of blockchains. The paper [9] proposes a different application of blockchains, namely for building an ecosystem for flexible and transparent incentivization of research through blockchains' feature for implementing the so-called "smart contracts". The proposed system aims to be self-controlling, without the need for a central regulatory unit.

V. Internet of Things (IoT)

This group includes papers [11,15], which are of both scientific and applied nature. These articles were also written in collaboration with candidate's PhD students. The articles are in the same field but on a different topic.

In [11], a specific system for monitoring and controlling carbon emissions from vehicles is proposed. A link to a prototype of the system is provided, in which most of the proposed components have been implemented. Details of all the technical solutions are presented and an algorithm is proposed for detecting anomalies based on which a control action can be applied.

In [15], the problem of optimal dynamic control of an infrastructure serving system in which there are mobile units is considered. An optimization model is constructed that aims to allocate the required number of computational resources at the appropriate locations so as to optimize a particular variable of the model. Techniques from integer linear programming are used. An algorithm that orchestrates the optimization of several variables is proposed. The new algorithm is experimentally compared with standard ones and situations in which the new proposed algorithm performs better are illustrated.

5. Critical Remarks and Recommendations

I have no substantive comments on the publications submitted to the competition. There are a few minor spelling errors and omissions in the provided documents. The papers on applications of blockchains do not clarify whether the systems described have been implemented or only designed. I recommend that the applicant also publish papers in which he is the single author. Verification of the submitted papers would be easier if a Document Object Identifier (DOI) or Internet link were provided for them.

6. Personal Impressions

I have no personal impressions of the candidate.

7. Conclusion

Based on the review of the documents and scientific publications submitted for this competition, as well as on the analysis of their significance and the theoretical and applied contributions, I hereby confirm that the scientific achievements of the candidate meet and exceed the requirements of ZRASRB, PPZRASRB, and PURPNSZADBAS for acquiring the academic position "Professor" in the scientific and professional field of this competition. More specifically, the candidate satisfies the minimal national requirements of the professional field and no plagiarism has been detected in the submitted scientific publications submitted.

I hereby state my **positive** assessment of the application of Assoc. Prof. Hristo Nikolov Kostadinov.

II. GENERAL CONCLUSION

Based on the above, I hereby **recommend** to the scientific jury to propose to the competent authority of the Institute of Mathematics and Informatics at Bulgarian Academy of Sciences to elect Assoc. Prof. Hristo Nikolov Kostadinov to the academic position "Professor" in professional field 4.6 Informatics and Computer Science, scientific field "Informatics" (Data security, Internet of things).

November 17, 2024 Prepared by: _____
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