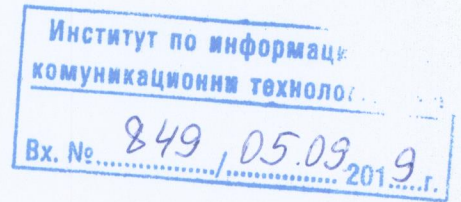# OPINION

For procedure for academic position „Professor", State Newspaper, No 41/21.05. 2019
Candidate: **Associated Professor Vladimir Vasilev Monov**

By Professor Krasimira Stoilova, DSc – Institute of Information and Communication Technologies – Bulgarian Academy of Sciences (IICT – BAS)

I am nominated as a member of the Scientific Jury according to Order № 181 from 19.07.2019 by the Director of IICT – BAS, on the base of solution of the Scientific Council of IICT-BAS about procedure for the academic position "Professor" in the scientific domain 4. "Natural sciences, mathematics and informatics", professional field 4.6."Informatics and Computer sciences", scientific specialty 01.01.12 "Informatics" for the needs of "Modelling and Optimization" department of IICT – BAS. Only one candidate – Associated Professor Vladimir Vasilev Monov has submitted documents.

1. General description of the presented documents

Associated Professor Vl. Monov is control engineer, graduated in Technical University-Sofia. He is a PhD from 1988 and associated Professor from 1999.

According to the official notice about total work experience which is 36 years, 33 years he is working like scientific researcher and Associated Professor.

2. General characteristic of the scientific and applied activity

Presented publications for the procedure are 25. They are different from these submitted to PhD and "Associated Professor". All publications are in English and 6 of them are individual [30, 34, 35, 36, 37, 38].

The scientific interests of assoc. Prof. Vl. Monov are in two main domains:
Theory of matrices and application of matrix analysis in the research of dynamical systems and processes [30, 33, 34, 35, 36, 37, 38, 39]

Modelling, analysis and optimization in information and communication systems [42, 44, 50, 57, 58, 60, 67, 69, 70, 71, 72, 74, 78, 79, 85, 96, 97].

3. Analysis of scientific and applied contributions
SCIENTIFIC CONTRIBUTIONS
Theory of matrices and application of the matrix analysis in the research of dynamical systems and processes

- Theoretical result in the domain of matrix analysis is derived by criterion of analysis of spectral set of convex set of quadratic matrices (dimension $n \times n$) [30]. In that manner the spectral characteristics of real and imaginary parts of the spectral set of the specters of the convex polyhedra in it, which have dimension less than $2n$, are determined. The advantage of this generalized result for larger class of problems in comparison with the known in the literature is the possibility for research of matrix convex sets by research of the properties of their sub-sets with simpler structure and lower dimension. Another advantage of this result is

the possibility to be used like criterion for analysis of the robustness stability of linear continuous and discrete systems with indefinite parameters.

- A new approach for determining the necessary and sufficient conditions for the reducibility of the quadratic matrices by using the theoretical technique of multi-linear algebra and exterior algebra, Grassman spaces and their vector representatives is derived [33]. A new criterion for single matrix reduction, which is generalized for reduction at the same time of couple matrices, is synthesized. An advantage of this approach is the possibility for reduction of the matrices and linear operators in different areas, including the theory of linear control systems.

- Further development of the known in the literature families of Newton's inequalities, which are limited to utilization of real variables by including elementary symmetrical functions with complex variables, is done [34]. A new result, expanding and generalizing the classical Newton's inequalities by complex numbers is obtained. Relation with different types of quadratic matrices which eigenvalues satisfy the complex form of Newton's inequalities is established. These results of the candidate have further development in publications on inequalities and matrix analysis by researchers from abroad.

- Theoretical results for nonnegative matrices are obtained [35], [37]. Properties of the derivatives of the characteristic polynomial of nonnegative matrices representing new extended and generalized results in the spectral theory of this class of matrices, known like Perron-Frobenius theory are established in [35].

- Set of inequalities connected functions of eigenvalues and diagonal elements of nonnegative matrices are proven [36], [37]. This is important in the research of other classes of matrices and in the analysis of positive dynamical systems.

- Mathematical apparatus for research of bi-linear matrix products is developed [38], [39]. Relation between these matrix products and special classes of matrices (associated and induced) and with the Kroneker's product and the standard matrix multiplication is established. They have applications in the theory of dynamical systems.

The research of Vl. Monov in the theory of matrices leads to original results and the problems there have further development in the publications of authors outside Bulgaria, including a dissertation of Dublin University. Because of the difficulty of the statement in [36] about the nonnegative matrices some followers have received results however they are limited only to particular cases. In the common case the formulated statement is not proven and it is an actual problem for future research.

Modelling, analysis and optimization in information and communication systems

Optimization approaches for the topology and the energy effectiveness of wireless sensor networks have been developed [96], [97]. Adaptive approach based on approach of weighted clustering of sensor network for generating sensor clusters is developed in [96]. The adaptive approach includes new functionality for node's clustering by using the method of priority of the quality of the links ensuring decrease of the risk of network crashes caused by the noise in the links. Model of wireless sensor node based on artificial neural network is developed in [97]. It allows effective energy control during the information transfer, optimizes the usage of resources and extends the time period of the battery powered wireless sensor networks.

SCIENTIFIC APPLICATIONS

Modelling, analysis and optimization in information and communication systems
- Effective control strategies for technological process of grinding in industrial ball mills, including methods of decentralized multi-connected and decoupling control, usage of PID-controllers and multivariable control are determined [44].
- Approach for development, design and production of combined tactile/voice interface allowing people with reduced vision to work with computers nevertheless of the standard user interface or operation system is developed [50]. New type of electromagnetic drive of the Braille display needles has been developed and its characteristics have been modelled and studied.
- Optimization algorithms for production schedules in industrial enterprises are synthesized [74]. They minimize the working time of production capacities, formalized by problems with different goal functions and constraints.
- Models of information traffic of a packet switch, used for implementation of conflict-free transfer of traffic requests in the system have been developed [42], [60]. Bandwidth estimates of the switch according to the corresponding algorithm for conflict-free transfer and random character of the input requests have been obtained.
- Algorithms for conflict-free scheduling in matrix packet switch have been synthesized: adaptive algorithm determining the weighted coefficients of the input requests and algorithm with sequential execution of the requests in the diagonal sub-matrices of the connections' matrix [78], [79], [85]. The performance, the speed and the necessary computer memory for implementation of the algorithms according to the size of the connections matrix are determined.
- A software platform on three layers with service-oriented architecture (SOA) for integration of heterogeneous data from intelligent sensor systems has been developed [67]. The advantages of this model are the analysis and integration of heterogeneous data and inclusion of additional functionalities on the different platform's layers.
- A new concept for analysis and preliminary appreciation of the economical effectiveness of implementation of control systems in small and medium enterprises has been developed [70], [71], [72]. Basic groups of criteria and evaluation methods have been determined.
- Wireless sensor intelligent module with sensor for temperature, humidity and barometric pressure and built-in module for GPS coordination has been developed [69]. The module has flexible architecture and allows operation in several modes. Adaptive algorithm optimizing the energy consuming in order to increase the time for autonomous work of the module has been developed. A patent application has been registered as a result of the development.
    I **appreciate positively** the theoretical and application contributions in the both presented scientific domains of the candidate.

4. Citations
The noticed citations of the presented in the procedure publications are 66 and only one publication No 44 is cited 45 times. 30 of the citations are indexed and refereed in Scopus and Web of Science publications.

5. Implementation of the minimal requirements and other activities
    Assoc.Prof. Monov satisfies and exceeds on nearly all criteria the minimal national requirements for the academic position "Professor". Requirements/Implementation on the

different indicators are: indicator A – 50/**50**; B – 100/**264**; Г – 260/**362**; Д – 140/**210**; Е – 150/**230**.

The common list of publications counts 104 publications, including one monograph in Bulgaria of the second scientific topic.

A list of reviews for the author's publications is presented. It shows that the Monov's results are well known; they are discussed and later develop from the world scientific society.

Assoc. Prof. Monov has an active project work. He is a project leader on different programs – National Innovation Fund 2007-2009, Operative Program "Development of the competitiveness of the Bulgarian economy 2007-2013". He has participation in many projects: ACOMIN – International project of 7th Framework Program of European Commission; Scientific exchange of knowledge with Russian Academy of Sciences 2011-2013; with Slovak Academy of Sciences 2015-2017; Erasmus Program 2013-2014 and 2016-2017; Operational Program "Competitiveness" 2012-2014 and 2019-2020; with National Scientific Fund 2017-2020; He is a supervisor in a Project of a young scientists and PhD students of Bulgarian Academy of Sciences 2017-2019.

A patent application "Method and device for monitoring and integration of data from meteorological sensors" by Al. Alexandrov and Vl. Monov has been registered at the Patent institution of Bulgaria. The invention is about method and mobile device for monitoring of meteorological data by adaptive algorithm for digital processing and integration of data from meteorological sensors and forecasting of future variation of this data for a period of time. It is applicable in distance measurement of atmospheric parameters and long-term studies of climate changes.

Assoc. Prof. Monov is a head of department "Modelling and Optimization" in IICT from 2010. He was a supervisor of a PhD student who successfully defended his dissertation and possesses the scientific degree PhD.

Assoc. Prof. Monov participates in the editorial board of the scientific journal „Cybernetics and Information Tecnologies". He is a reviewer in many international journals.

Assoc. Prof. Monov has active scientific, applied, expert's, organizational and leader's activity which characterized him like high quality scientists with international prestige.

Conclusion: On the base of the presented documents, scientific and applied contributions, and on the base of the complex appreciation of the other criteria of the procedure, I give my **positive opinion** and **strongly recommend** to the honorable Scientific Jury to propose to the Scientific Council of IICT-BAS to award Assoc. Prof. Vladimir Monov the academic position "Professor" for the needs of "Modelling and optimization" department, professional field "4.6. Informatics and Computer sciences", specialty 01.01.12. "Informatics".

05.09.2019   Member of Scientific Juri:

Professor K. Stoilova, DSc.

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