R E V I E W

by Prof. Doctor of Mathematical Sciences Ognyan Ivanov Kounchev,
IMI - BAS,

Chairman of Scientific Jury on a competition for occupying the academic position of “professor”,

in professional field 4.6 “Informatics and Computer Science”, scientific speciality “Informatics” (Information Modeling)

The present review has been prepared on the basis of Order No. 36/ 05.02.2020 of the Director of the Institute of Mathematics and Informatics - BAS, Acad. Vesselin Drensky on the grounds of Art. 4 (2) of LDASRB and a decision of the Scientific Council of IMI - BAS (protocol No. 1/ 24.01.2020). It is in compliance with the requirements of the Law for the Development of the Academic Staff in Republic of Bulgaria (LDASRB), the Regulations for its Application (RALDASRB) and the Regulations of IMI - BAS. The review consists of **three** parts and a conclusion.

I. Requirements to the applicant

by Art. 29 (1) and Art. 29b of LDASRB, Art. 60 of RALDASRB and Art. 2 (1) and Art. 3 (1), item 3 of the Regulations on the Conditions and Procedure for Acquisition of Scientific Degrees and Occupation of Academic Positions in IMI - BAS

Assoc. Prof. Dr. Zlatinka Svetoslavova Kovacheva graduated with excellent grades and a master's degree in mathematics in 1981 at the Faculty of Mathematics and Mechanics, Sofia University “St. Kliment Ohridski,” specialization Foundations of Cybernetics and Control Theory. In the period 1983-1986 she was a Ph. D. student at the Central Institute of Computing Technique and Technology, Sofia. In 1987 she defended a thesis for acquisition of the scientific degree “Ph.D.” at the Technical University, Sofia (Diploma No. 16620/ 31.03.1987 issued by the Higher Attestation Commission at the Council of Ministers of People’s Republic of Bulgaria).

In the academic years 1984-1985, 1985-1986, 1989-1990, 1990-1991 she worked as a part-time assistant in Mathematical Analysis at the Technical University, Sofia. In the period 1987-2003 she worked as a Research Associate, 2nd and 1st grade at the Institute for Information, Communication and Automation Systems and the Center for Information Technologies in Communications, where she was Head of Section. In the period 2004-2015 she was Assoc. Prof. at the Higher School of Telecommunications and Post, Sofia (Certificate No. 22472/11.06.2004 issued by the Higher Attestation Commission at the Council of Ministers of Republic of Bulgaria). From 2005 to 2018 she taught mathematics at Sultan Qaboos University, Higher College of Technology and Middle East College in Sultanate of Oman. In the period 2013-2018 she was Professor and Head of the Department of Mathematics and Applied

Sciences at Middle East College in Sultanate of Oman. In 2018 she returned to Bulgaria and started work at the Institute of Mathematics and Informatics - Bulgarian Academy of Sciences as Assistant Professor. Since 2019 she has been Assoc. Prof. on a second labor contract in St. Ivan Rilski University of Mining and Geology – Sofia.

The applicant has more than 5 years of work experience as Associate Professor in Bulgaria and 5 years of work experience as Professor in Sultanate of Oman, according to the attached documents.

She has participated in and managed scientific-research projects from the scientific plans of the Central Institute of Computing Technique and Technology, the Institute for Information, Communication and Automation Systems, the Center for Information Technologies in Communications and the Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences. Projects managed by her have been successfully implemented throughout the country, according to the attached documents.

She is a member of the Union of Scientists in Bulgaria. She was in the Scientific Council of the Higher School of Telecommunications and Post, as well as of the Academic Board and the Academic Affairs Committee of the Middle East College in the Sultanate of Oman.

She has participated in a number of scientific and program committees of international conferences in Romania, Turkey, Canada, Oman, Italy, Spain and France. She has chaired and coordinated sessions in these.

She has reviewed papers in international scientific journals and proceedings of international conferences. In 2009 and 2010 she refereed projects for the Scientific Research Fund of the Ministry of Education and Science of Republic of Bulgaria.

From the inspection of the submitted materials for the competition I do not establish violations in the procedure for eligibility of the candidate to the competition and I accept the materials for review.

II. Requirements to the scientific research and applied-scientific activity

by Art. 29 (1), items 1, 3, 4, 5, 6, (2) and (3), Art. 29b (1) of LDASRB, Art. 60 (1), items 3, 4, 5, (2) and (4) of RALDASRB, Art. 2 (1) and Art. 3 (1), item 3 of the Regulations on the Conditions and Procedure for Acquisition of Scientific Degrees and Occupation of Academic Positions in IMI - BAS

From the scientific works of Assoc. Prof. Dr. Zlatinka Kovacheva submitted for the competition I established that they do not repeat the publications used for the acquisition of the scientific degree “Doctor” and for the acquisition of the academic position “Associate Professor”. The following documents have been submitted: 1) a list of scientific works, summaries in Bulgarian and English, and copies of the scientific works for participation in the competition; 2) information on the citation of her scientific works; 3) information on participation in and management of scientific-research and applied projects; 4) extended author’s annotation of the results obtained in each of the scientific works and main contributions; 5) information on satisfying the minimal requirements for occupation of the academic position “Professor”.

Scientific works. The list of scientific works submitted by Assoc. Prof. Dr. Zlatinka Kovacheva for the competition contains 32 items, of which one chapter of a book.

All submitted publications are written in English. 27 publications are in international publishing houses or abroad. Ten (10) of these are in editions with IF or SJR.

The publications with numbers:

1. [4,10,22,32] are published in international journals with IF;
2. [4,5,10,14,17,18,22,23,24] are published in international journals or in proceedings of international conferences possessing SJR;
3. [4,10,12,17,18,22,23,24,30,32] are indexed in WoS;
4. [4,5,10,14,17,18,19,22,23,24,32] are indexed in Scopus;
5. [4,5,7,10,21,23,24,26,29,30,32] are indexed in MathSciNet;
6. [4,5,10,21,23, 29,30,32] are indexed in Zentralblatt;
7. [19] is indexed in ACM;
8. [1,2,3,6,8,9,13,15,16,20,25,27,28,31] are published in proceedings of international conferences or in international journals refereed and indexed in other scientific databases;
9. [11] is a chapter of an open-access book having ISBN.

Citations of the scientific works. Seven of the publications have been cited altogether 202 times in the world-known scientific databases Scopus and Web of Science. Below is given the distribution of the publications' citations with their respective numbers:

1. [32] (IF - Q4, SJR) has been cited 11 times;
2. [10] (IF - Q2, SJR) has been cited 181 times;
3. [23] (SJR) has been cited 1 time;
4. [22] (IF - Q4, SJR) has been cited 1 time;
5. [5] (SJR) has been cited 6 times;
6. [4] (IF - Q3, SJR) has been cited 1 time;
7. [18] (SJR) has been cited 1 time.

Three publications have been cited in theses or theses' abstracts, as follows:

1. [32] (IF - Q4, SJR) has been cited 2 times abroad and 1 time in Bulgaria;
2. [10] (IF - Q2, SJR) has been cited 7 times abroad;
3. [9] has been cited 1 time abroad.

Participation in and management of projects. Assoc. Prof. Dr. Zlatinka Kovacheva has managed 7 scientific-research projects at the Center for Information Technologies in Communications assigned by BTC Ltd. Documents on the successful implementation of some of them throughout the country have been presented. She has participated in the development of other two projects at the Center for Information Technologies in Communications. One of these is with the participation of Sprint International Corporation, Reston, Virginia, USA.

Published textbooks and study manuals. Assoc. Prof. Dr. Zlatinka Kovacheva has participated in the preparation of two university textbooks – Intermediate Calculus and Intermediate Mathematics for Middle East College,

Muscat, Oman, approved by Coventry University, UK. She has also participated in the preparation of electronic lectures in Engineering Mathematics 2 and Probability for Middle East College, Muscat, Oman.

From the information and number of points in the separate indicators given by the “Generalized table” it is seen that the applicant satisfies the minimal national requirements for the occupation of the academic position “Professor”.

GENERALIZED TABLE

FOR THE VOLUME AND TYPE OF THE SCIENTIFIC PRODUCTION by Art. 1a (1) and (2) of RALDASRB and Art. 2(1) of the Regulations of IMI - BAS

of Assoc. Prof. Dr. Zlatinka Svetoslavova Kovacheva

Group_of indicators	For participation in a competition for professor	
	Number of points of the applicant	Required number of points
А	50	50
Б	-	-
В	102	100
Г	235	220
Д	1152	140
Е	210	150
Sum	1749	660

Scientific research and applied activity. The scientific research of Assoc. Prof. Dr. Zlatinka Kovacheva is concentrated in several areas such as OLAP (Online Analytical Processing), Big Data, Data Mining and Neural Networks as follows:

1) OLAP developments (publications with numbers 6, 25, 30);
2) Big Data (publications with numbers 2, 13, 19, 28);
3) Data Mining (publications with numbers 8, 9,18);
4) Continuous neural networks (publications with numbers 5, 10, 11, 15, 16, 22, 23, 26, 27);
5) Discrete neural networks and other discrete systems (publications with numbers 1, 3, 7, 11, 12, 14, 15, 17, 24, 29, 31, 32);
6) Second-order impulsive differential equations with nonlocal conditions (publications with numbers 4, 20, 21).

The main contributions of the applicant are in the areas of applied informatics mentioned above.

In the OLAP developments, unconventional approaches to the modeling of fact-tables in Data Warehouses are discussed, in order to provide the multidimensional presentation of the data. An architecture approach to the Data warehouse building, focused at maintaining the dependences between the data and its consistency and duplication has been presented [6]. To solve the problems with the big data sparsity in the OLAP hyper-cubes, an innovative model of regular sparsity map is presented which allows implementation of set operations between the regular sparsity map and rectangular domains in the multidimensional cube [30]. The tests of the described approach over real data cubes show significant reduction of the cube storage size.

Another direction of applied informatics where the candidate has contributions is Big Data. Data Warehouses, Cyber-physical systems and many others put a sequence of problems related to the Big Data processing and analysis. In [2], some aspects of Big Data analytics for cyber-physical systems are discussed from different points of view – statistical, mathematical, computational, legal, etc. and corresponding solutions are proposed. In [13], the emphasis is laid on the main advantages of neural networks in the process of Big Data analytics. In [19], a set of solutions for Big Data processing, which are a part of the main data storage and analysis technologies, offered by ORACLE, is discussed. The conclusions are presented on the base of real data tests.

In [8], a Data Mining method for students advising and course plan construction, on the base of associative rules, using the existing Academic Database of the Higher College of Technology, Muscat, Oman, is proposed. In [18], some experiments of applying Data Mining methods, provided by the analytical engine of RDBMS Oracle, over Big Data stored in Hadoop Distributed File System (HDFS) are presented. The application of neural networks for Data Mining is discussed in [9].

In [10, 16, 27], additive neural networks of Hopfield type with impulses in the case of continuous time are considered. In the cases without delays, with discrete delays, and with delays distributed over an infinite interval, sufficient conditions for the global exponential stability of a unique equilibrium point are obtained by means of appropriate Lyapunov functionals. A sufficient condition for the existence of a periodic solution of a class of Hopfield-type neural networks with bounded distributed delays and impulses in integral form has been found, as well as sufficient conditions for its uniqueness and global exponential stability.

In [23, 26], an impulsive Cohen-Grossberg neural network with time-varying and distributed delays of Stieltjes type and reaction-diffusion terms is considered. Using the nonpositivity of the reaction-diffusion operators, under appropriate conditions in terms of M-matrices it is proved that the system with zero Neumann boundary conditions has a unique equilibrium point which is globally exponentially stable. Making use of the Hardy-Poincaré inequality, improved stability estimates for the system with zero Dirichlet boundary conditions are obtained. Examples are given.

In [5, 22], neural networks of neutral type are considered. Sufficient conditions for existence and global asymptotic stability of a unique equilibrium point of a

neutral-type Cohen-Grossberg neural network are obtained. An example is presented to illustrate that these conditions are much more precise than those obtained earlier by C.-J. Cheng, T.-L. Liao, J.-J. Yan and C.-C. Hwang.

In [7, 29, 31, 32], discrete counterparts of additive neural networks of Hopfield type with continuous time and impulses are formulated by the semi-discretization method. In the cases without delays, with discrete delays, and with delays distributed over an infinite interval, sufficient conditions for the global exponential stability of the equilibrium point are obtained. The global exponential stability of the periodic solution is investigated.

In [24], a discrete counterpart of a class of Hopfield neural networks with impulses, and with both concentrated and infinite distributed delays, as well as with a small delay in the leaking (stabilizing) terms, is formulated by an appropriate difference approximation of the derivatives. Sufficient conditions for existence and global exponential stability of a unique equilibrium point of the discrete-time system considered are obtained by the introduction of an appropriate Lyapunov functional.

Sufficient conditions for the existence of periodic solutions for a discrete-time counterpart of a neutral-type cellular-neural network with time-varying delays and impulses are obtained in [12, 17] by using Mawhin's continuation theorem from the coincidence degree theory.

The discrete counterpart of a complex-valued neural network of Hopfield type with time-varying delays and impulses is considered in [3, 14]. Sufficient conditions for existence and global exponential stability of a periodic solution of the discrete-time system thus obtained are found.

In [4, 20, 21], a class of second-order differential equations in Banach spaces provided with impulse and nonlocal conditions is studied. Theorems for existence of mild and classical solutions are proved.

Teaching activity. Assoc. Prof. Dr. Zlatinka Kovacheva has delivered lectures and conducted tutorials in "Higher Mathematics" - Parts 1, 2 and 3, "Numerical Methods and Foundations of Programming" and "Applied Statistics" to the students of St. Ivan Rilski University of Mining and Geology, Sofia. She has delivered lectures and conducted tutorials in "Information Technologies", "Applied Information Systems in Communications", "Marketing of Telecommunication Services" and "Operator Management in Communications" to students of the Higher School of Telecommunications and Post, Sofia. She has conducted tutorials in "Mathematical Analysis" in the Technical University, Sofia. She has delivered lectures and conducted tutorials in "Calculus"– 1 and 2, "Calculus for Engineers" – 1 and 2, "Discrete Mathematics", "Basic Mathematics", "Pure Mathematics" in the Higher College of Technology in Muscat, Oman. She delivered lectures and conducted tutorials in "Intermediate Calculus", "Intermediate Mathematics", "Engineering Mathematics 2", "Pure Mathematics", "Applied Mathematics" in Middle East College, Muscat, Oman, where she was Head of the Department of Mathematics and Applied Sciences. She supervised 4 graduate students of bachelor programs in the Higher School of Telecommunications and Post, Sofia.

Contributions. The author's annotation of the scientific works of Assoc. Prof. Dr. Zlatinka Kovacheva is detailed and reflects the main results in the publications. The contributions have been clearly formulated and can be generalized as follows:

An architecture approach to the Data warehouse building, focused at maintaining the dependences between the data and its consistency has been presented. An innovative model of regular sparsity map is developed, which allows implementation of set operations between the regular sparsity map and rectangular domains in the multidimensional cube. A Data Mining method for students advising and course plan construction, on the base of associative rules, using the existing academic database, is proposed.

Discrete counterparts of various classes of continuous neural networks (including complex-valued) with delays and impulses have been introduced. Sufficient conditions for existence of equilibrium points and periodic solutions of the continuous- and discrete-time neural networks considered, as well as for their uniqueness and stability have been found. The notions of mild and classical solution for some classes of second-order differential equations in Banach spaces have been introduced, and sufficient conditions for existence, uniqueness and continuous dependence on initial conditions of the aforementioned solutions have been obtained.

III. Opinions, recommendations and remarks

I have not found substantial errors, inaccuracies and omissions in the presented materials. I recommend to pay more attention to the modern applications of the Big Data and Data Mining approaches to various up-to-date fields of telecommunications, which is an essential motivation of the present professorship.

Conclusion

From the inspection of the submitted materials for the competition no violations in the procedure have been established. All requirements of Art. 29 (1), (2), (3), Art. 29b (2), (3) of LDASRB, Art. 60 (1) (2) and (4) and Art. 61 (1), (3) of RALDASRB, Art. 2 (1) and Art. 3 (1), item 3 of the Regulations on the Conditions and the Procedure for Acquisition of Scientific Degrees and for Occupation of Academic Positions in IMI – BAS have been observed.

A substantial part of the publications of Assoc. Prof. Dr. Zlatinka Kovacheva have been refereed in the world-known scientific databases Scopus и Web of Science and have got recognition, which is proved by the numerous citations by foreign authors. The results obtained, the contributions to science and the implementations into practice justify me to claim that Assoc. Prof. Dr. Zlatinka Kovacheva is a built specialist in the field of information modeling. I think that her scientific activity deserves to be highly assessed, and I suggest to the members of the respected jury to vote on a proposal to the Scientific Council of IMI – BAS to assign the academic position "Professor" to Assoc. Prof. Dr. Zlatinka Kovacheva.

15.04.2020 REVIEWER**:**

Sofia