

REVIEW

on the competition of taking the academic position “Associate Professor” in professional area 4.6 “Informatics and computer sciences”, speciality “Informatics”, announced in State Gazette issue 41 of May 21, 2019 with candidate: Boriana Emilova Vatchova, Assistant Professor, PhD
Reviewer: Petko Hristov Petkov, Professor, DSc

1. General and biographical data

In the competition for taking the position “Associate Professor” in “Informatics and Computer Sciences”, speciality “Informatics” at the Institute of Information and Communication Technologies (IICT) of Bulgarian Academy of Sciences (BAS) - Sofia participates only one candidate – Dr. Boriana Emilova Vatchova, Assistant Professor in the Section “Hierarchical Systems” of IICT. The candidate graduated from the Technical University of Sofia with the speciality “Systems and Control” with qualification “Engineer in Electronics and Automation” in 1992. In the period of 2004-2009 she was PhD student in IUSI-BAS where she obtained the scientific degree “Doctor” in 2009 with dissertation on the topic “Extraction and reliability estimation of knowledge on multifactor technological processes”. From 1995 to 2006 she was research associate 3rd degree and from 2007 to 2010 – research associate 2nd degree at the Institute of Information Technologies – BAS. From 2010 she is an Assistant Professor at IICT-BAS, Section “Hierarchical Systems”. Vatchova participated in several seminars held in Spain, Germany and Italy. She speaks English and German.

The competition is announced in State Gazette, issue 41 of May 21, 2019 based on a decision of the Scientific Council of the IICT. The formal requirements in connection with the procedure are fulfilled in the necessary time.

2. General description of the presented materials

The candidate participates in the competition with 16 works which do not repeat the works presented to acquire the education and scientific degree “Doctor”. Of these works, 1 is a monography with the title “*Extraction of knowledge by the methods of artificial intelligence and multi-valued logic*”, published this year and the rest are papers in scientific journals or presented on conferences, published in the period 2005-2019. Three of the works are book chapters published abroad, 8 are papers published in foreign periodic editions, and 4 are papers presented at international scientific conferences. All publications (except monography) are indexed and referred in Scopus and/or Web of Science. Two publications have impact-factor and 10 – SJR. Three works (including the monography) are without co-authors, 2 are with one co-author, 6 with two co-authors and the rest – with 3 or more co-authors. A detailed reference is presented for 15 citations of the applicant’s works, 12 of them being in foreign editions.

Documents are presented for participation in 4 scientific projects and contracts, one of them with partners from the Technical University of Dresden. There is no information about participation in organization or program committees of scientific meetings.

3. General characteristic of the applicant's research, scientific and development activities

The candidate has a significant scientific research production in the area of artificial intelligence, result of successful work in the period 2005-2019. Assist. Prof. Vatchova has several scientific and science application contributions in the area of knowledge extraction for complex processes and modeling of multifactor stochastic plants, published in prestigious foreign editions. Apparent is a sufficient number of citations of her works by Bulgarian and foreign authors. She has also lecturing activity in a high school. This characterizes Assist. Prof. Vatchova as a researcher with significant scientific research, applied science and pedagogical activity.

4. Key scientific and applied science contributions

The works presented by the candidate are associated with the development of new methods in knowledge extraction for complex processes and modeling of multifactor nonlinear stochastic processes. The contents of these works shows that the candidate works on the perfection of the approaches used and desires to extend the possible application areas. As most significant scientific and applied science contributions, I want to point out the following ones.

1. Scientific contributions

In the applicant's works are published serious results in the area of artificial intelligence. Specifically, the following results are obtained.

- In works [4] and [14] a model with network structure is proposed intended for extraction of knowledge for complex processes. The network structure involves three layers: input layer with number of elements in it corresponding to the number of input measurable factors in the plant; intermediate layer with number of elements in it corresponding to the numbers of dominating grouped sets in the package of experimental input data; output layer with a number of elements in it corresponding to the number of realized logical values at the one of plant outputs. The models of the different outputs are distinguished from the model of given output only by the connections and their gains between the intermediate and output layers. The elements of the input layer are fed by the realized logical values of the inputs which can be accounted. To each element of the intermediate layer act signals from all elements of the input layer. The output of each element of the intermediate layer act on the input of the elements of output layer. The connections between the elements of the three layers are gains. These correspondence (relations) are respectively: relation between the relative values which correspond to the logical values of the input and the relative values participating in the corresponding dominating set; relation between the frequencies of realization of the elements of the

sets of input and intermediate layer; relation between the relative values of the elements of the intermediate and these of output layer; relation between the frequencies of realization of the elements of intermediate and output layer. The network model allows to compute the logical values and probabilities of realization of the output under consideration. A network model is developed with three inputs and one output. The model is applied to a technological process.

- In the monography and works [8] and [14] a method is proposed for modeling of multifactor nonlinear stochastic plants. For time-variant plants the production plans are changed by the newly coming experimental data. By the production rules obtained, it is possible that all input factors are not covered. To realize completion of the missing production rules is necessary to make interpolation between the existing close production rules of MLPF (multivalued logical and probability function). A method is developed for modeling of multifactor nonlinear stochastic plants. With these particularities are characterized complex plants from different application areas like technological, energetic, heat, transport and others. The method and the associated with it applications are tested multiply by real experimental data and are brought to practical application;
- In work [3] a method is proposed for faster direction to the local extremum by the aid of genetic algorithms and gradient method. A new approach is used associated with combination of the methods of GA (genetic algorithms) and pseudo-gradient method. In this way one achieves reduction of the number of experiments and the number of arguments in the objective function is changed. When a "pseudo-gradient" method is used this leads to direct search of the extremum. A numerical example is presented which shows that after three stochastic iterations on the basis of the genetic algorithm one achieves plant changing in the direction of the local extremum. The method considered in the paper shows not only direction to the extremum but also change of the state coordinates which are purposefully changed according to the searched extremum.

2. Science application contributions

- In works [11], [14] and [15] a method is proposed for extraction of knowledge about time-variant processes by combination of the data in packages using MLPF (multivalued logical and probability function). The known methods for knowledge extraction are based on stochastic procedures which are not accompanied by algorithms for changing the knowledge in real time. It is shown that the algorithms performs successfully, using logical and statistical procedures, where flexible arrays of data are introduced in a way in which the new data dropped out and new data is added. These data are packed in groups and are transformed into logical values of functions of multivalued logic (data is used for floatation of copper ore obtained by automatic analyzers in the concentration enterprise "Elatcite"). These functions are with some degree of probability for each value of the logical values which are estimated in real time. In this way a new construction is introduced formed as MLPF which expresses

two interconnected correspondences – logical and probabilistic. These correspondences are changed in real time. MLPF is a system of production rules which are changed in real time;

- In the monography and in work [10] a logical method is proposed for extraction of knowledge on the basis of experimental data for a technological process for floatation of copper ore. A method is presented for extraction of knowledge from real data for complex process in the mining industry. The data are transformed from numerical values into relative values and then into logical values. Using this method one obtains more exact and reliable knowledge for the investigated plant. Created are bases of rules of the multivalued logic. These bases of rules are used for purposes associated with prediction, control and analysis of complex processes characterized by uncertainty. The method is considered with real data from a passive experiment for floatation of copper ore, obtained in laboratory conditions;
- In works [1, 2, 5, 6, 7, 9] an application of innovative theory of fuzzy networks with rule bases from different types complex processes and plants. A simulation in the environment of MATLAB with Fuzzy Logic Toolbox is done for systems with one base of rules, for system with several bases of rules and for a network with base of rules. Real data for floatation process are used as well as other processes.

All contributions considered above are done by the candidate and are presented in detail in her monography. Apart from the personal contributions, the monography contains a very wide survey on the application of artificial intelligence in control systems and corresponds entirely to the requirements for a habilitation work, presented for obtaining the degree “Associate Professor”.

5. Significance of the contributions to science and practice

The results in the area of artificial intelligence obtained by the applicant represent scientific contribution and have application in several areas. As it was noted in Sect.2, the applicant works are cited 15 times abroad and at home, which makes reasonable to think that the contributions of Assoc. Prof. Vatchova have obtained the necessary recognition by the scientific community at home and abroad.

6. Evolution of teaching capabilities and activities of the applicant

During the last 4 educational years the applicant gave lectures on “Software Engineering” in the master educational degree of the High School for Telecommunication and Posts in the volume of 30 hours lectures and 30 hours seminar exercises each year. That is why I accept that the pedagogical activity is sufficient.

7. Critical remarks and recommendations

I have not significant remarks about the materials presented. The documentation presented is complete and the presented claims are reasonable.

8. Fulfilment of the minimum state criteria

I declare the fulfilment of the normative requirements in respect to the national and institutional scientific data for the area "Natural sciences, Mathematica and Informatics" to occupy the position "Associate Professor" by group of indicators as follows: A = 50 points, B = 100 points, G = 260 points, D = 70 points, E = 20 points.

CONCLUSION

The significant scientific and science application contributions of the candidate, their publication in prestigious international editions and the sufficient number of citations of the works make me convinced to propose Assist. Prof. Boriana Emilova Vachova to take the academic position of "Associate Professor" in the professional area "Informatics and computer sciences", speciality "Informatics".

18.09.2019

Reviewer:



/Prof. Petko Petkov, DSc,
Technical University of Sofia/