

## OPINION

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**Concerning scientific works submitted for participation in competition for awarding the academic position of "Associate Professor" in professional field 5.3 "Communication and Computer Engineering"; scientific specialty "Communication Networks and Systems", which was officially announced in State gazette, issue 58 from 23.07.2019 and on the website of TU-Gabrovo to meet the needs of department "Communication Technologies and Equipment" which is a constituent unit of the Faculty of Electrical Engineering and Electronics; with applicant: Chief Assistant Professor Ivelina Stefanova Balabanova, Ph.D.**

### **1. An overview of the content and results of the works presented**

In relation to the competition, a total of 43 scientific papers, respectively 1 monograph, 37 publications in collections of scientific conferences and journals domestically and abroad, and 5 teaching and methodological guidelines have been submitted for opinion. I accept 43 pieces for review. The publications can be divided into the following categories - 18 in Bulgarian language; 19 in English language; 5 independent; 32 co-authored; 2 with Impact Factor (IF); 9 indexed in Scopus, one of which with IF; 1 with IF indexed in Web of Science.

Scientific works can be classified in two main directions:

- modelling of processes and objects with application in telecommunication transmission lines and optical communications with relevant publications [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 32, 33, 36 and 37] and guidance [4];
- designing virtual tools and creating objects for identification of noise identification during signal processing in communication circuits, including scientific works [27, 28, 29, 30, 31, 34, 35], manuals [1, 2, 3, 5] and monograph work [6].

### **2. General characteristics of the applicant's activities**

#### **2.1. Academic – pedagogical activity (work with students and Ph.D. students)**

Chief Assist. Prof. Ivelina Balabanova, Ph.D. was appointed Assistant in the Department of Communications Equipment and Technologies in Faculty of Electrical Engineering and Electronics of the Technical University of Gabrovo in 2005, and in 2007 was appointed Chief Assistant.

In her capacity of Professor she conducts seminars and laboratory exercises on "Training practice", "Signals and systems", "Communications circuits", "Telecommunications transfer lines" and "Communications and multiplex engineering" of students from the academic qualification degree of Bachelor, I, II, III and IV course in correspondence and regular form of study of specialties "Mobile and Satellite Communications" and "Communications Equipment and Technologies". The candidate leads lectures in the following subjects "Communications circuits", "Communications and multiplex engineering", "Telecommunication transmission lines", "Theory of teletraffic" and "Electromagnetic compatibility" for students in academic qualification of Bachelor and Master degrees in correspondence and regular form of study in III and IV course, as well as a third semester for the academic qualification of Master degree. She also leads lectures and laboratory exercises

in the disciplines "Communication circuits" and "Optical communications" of Masters in preparatory course of study in the college of the town of Lovech.

In its educational pedagogical activity Chief Assist. Prof. Ivelina Balabanova, Ph.D. has guided 56 graduates in academic qualification of Bachelor and Master degrees. The reviews she wrote for on theses were 37. She has been a member of state examination boards for 53 times. During her work with students and graduates, as well as in her scientific researches, she applied a number of software products such as LabVIEW, MATLAB, STATISTICA, Visual Basic, Altium Designer, Multisim, computer networks design and diagnostics software such as Cisco Packet Tracer etc.

## **2.2. Scientific and applied-scientific activities**

Chief Assist. Prof. Ivelina Balabanova, Ph.D. has been involved in the teams of 7 internal TU-Gabrovo completed project as one of them is a joint participation with - Ministry of Economy, Energy and Tourism. She was a manager of one project.

Scientific and applied-scientific interests of the candidate are focused in the areas of optical communications and teletraffic design, computer modelling, neural and neuro-fuzzy systems, Data Mining processes and others.

## **2.3. Implementation activity**

The candidate's implementation activity is related to the introduction into the educational process of the disciplines she has developed, the laboratory exercises and installations, as well as software applications for research and analysis in the field of optical communications and digital signal processing. With regard to the contract she was managing, a web- based information platform was implemented to analyse the processes and factors in broadcasting television signals and improving the quality of service.

## **3. Contributions (scientific, applied-scientific, applied). Importance of the contributions to science and practice**

Analysing the materials submitted to me for opinion, their contributions can be summarized as scientific and applied, divided in the indicated directions.

First applied scientific contributions:

- optical impulse transmission processes and CSO, CTB and CNR effects in fibre optic systems are analysed. It has been found that the sensitivity of the receiver sharply deteriorates when the pulse extension is about 0.3 times the length of the input and pulse, and the arrangement and mode of the QoS boost elements are established;
- methods were developed for calculating the optoelectronic analogue circuits, drivers for control of laser diodes, determining the probability of failure in a network with spectral multiplexing and limiting the impact of the problems with the asymmetry of channels in cable television networks;
- artificial neural networks have been selected for the recognition and classification of telecommunication systems with apparent losses, model parameters of voice services, serving devices in the  $D+M+H_2+E_3/D/n/k$  system and Markov chains;
- different architectures were tested of neuro-fuzzy systems in parameter identification and serving devices of Teletraffic models and voice sources and system  $D+M+H_2+E_3/D/n/k$  and Markov chains with and without restriction sites waiting in the queue;
- the types of structures for multiple choice decision and metric units for distances methods decision tree were analysed, as well as k - nearest neighbours for

categorization of Markov chains with limited and unlimited amount of line, systems with apparent losses, patterns of voice services and  $D+M+H_2+E_3/D/n/k$  systems;

- mathematical models are derived in planning experiments and regression analysis to determine the average idle time in the system and likelihood for losses in Teletraffic model of voice services;
- the effect of call intensities was evaluated and  $\lambda_1$  and the time  $t_d$  on the average idle time in the system and the likelihood of losses in the voice service model in cases without and with planning experiment plans;
- in design of experiment of Markov chains in one and a plurality of server stations regression models are derived for prediction of the changes of the moments of uptake and release of user requests serviced by the system.

First direction applied contributions:

- schematic solutions have been developed for generating phase impulses, converting lightning and two lightnings into impulse sequence and electronic instrument for multi-channel air temperature measurement;
- LabVIEW- based applications have been created that implement neural and neuro-fuzzy diagnostics for the quantitative identification and analysis of teletraffic service devices and incoming traffic.

Scientific contributions in the second direction:

- A copyright monographic work was written related to models synthesis for data extraction in electrical signals processing with added noise based on artificial neural networks, adaptive neuro-fuzzy interface systems, methods  $k$  - nearest neighbours and decision tree, discriminant and regression analysis, Bayes classification.
- Discriminant linear and neuro-fuzzy classifier for identification of analog and digital signals were synthesized with the presence of the "Periodic random noise and Inverse F noise" and "Uniform white noise and Inverse F noise";
- multilayer architectures of artificial neural networks are studied with back propagation of error identification signal with and without superimposed on six types of noise;
- information systems have been developed to design and investigate the characteristics of digital filters with authorization to access Microsoft SQL and MySQL databases for remote management for scientific and educational purposes.

Second direction contributions:

- virtual tools have been created for computer modeling, research and analysis of the behavior of recursive and non-recursive filters, digital processing and statistical analysis of signals;
- architectures are designed of relational databases Microsoft SQL and MySQL environments to gather data during, before and after filtering electrical signals.

#### **4. Assessment of the candidate's personal contribution**

I can evaluate the individual contribution of Chief Assist. Prof. Ivelina Balabanova, Ph.D. in the presented research and results as significant for theory and practice. I mainly focus on her innovative application of mathematical tools used in identifying signals that reflect different types of telecommunication noise.

Acknowledgments for the contributions of the candidate were received honors and prizes for presented reports at Conferences with international participation at the Angel Kanchev University of Ruse and Student Scientific Session at TU-Gabrovo.

## **5. Critical notes and recommendations**

I have some minor remarks regarding the materials presented, such as:

- material [32] in the publication list, indicated as indexed in the Web of Science in the author's reference of the candidate, is the only publication in a foreign journal;
- in the author's reference of the 10 publications referenced in Scopus, in fact they are 9, 1 of the IF material is indexed in Web of Science;
- Some repetitions and stylistic inaccuracies are noticeable in the publications.

The remarks made do not in any way undermine the work of Chief Assist. Prof. Ivelina Balabanova, Ph.D. As recommendations for her future scientific and creative work, I can advise that she should continue to publish in publications indexed in world-renowned databases and those with an impact factor, as well as find opportunities to integrate her business achievements.

## **6. Conclusion:**

**In view of the above said, I propose Chief Assist. Prof. Ivelina Stefanova Balabanova, Ph.D. to be elected as an "Associate Professor" in the field of higher education - 5. Technical Sciences, professional field - 5.3. Communication and Computer Engineering, specialty - "Communication Networks and Systems".**

20.10.2019 y.

/signature/  
Jury Member:/ Prof. Georgi Iliev, Ph.D. /