O P I N I O N

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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-Gaborovo 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. General characteristic of scientific-research and applied-scientific activity of the applicant

The quantitative characterization of the applicant's scientific-research activity and applied-scientific activity is directly derived from the applicant's publication reference, which has the following content: 1 monograph, 37 reviewed publications and 5 teaching manuals, classified as follows:

- Monograph – 1;
- Total publications abroad – 9 (№ 4,6,7,8,26,29,32,33,35);
- From them – foreign journal papers – 6 (№ 6,26,29,32,33,35);
- From them in indexed journal Web of Science – 1 (№ 32).
- At Bulgarian scientific journals – 12 (№ 9,10,11,12,13,14,16,17, 18,19,22,23);
- At scientific conferences with international participation held in Bulgaria – 13 (№1,3,4,5,15,19,20,27,28, 30,31,36,37);
- At international scientific conferences held abroad – 4 (№ 2,7,8,32);
- Of independent authorship – 5 (№ 1,2,3,10,12);
- Training manuals - 5 (№ 1,2,3,4,5).

2. An overview of the content and results of the works submitted

Scientific publications can be classified into two groups:

1. Telecommunications and transfer systems and optical communications:
   (№1, 2 (papers with Impact Factor); (№1 - WoS); (№4, 5, 6, 7 – SCOPUS); № 3, 4, 5, 6, 7, 8, 9,10, 11, 12, 13, 14, 15,16, 17, 18, 19, 20, 21, 26, 27) publications outside of SCOPUS and WoS); (№4 - training manual).

2. Communications circuits, methods and algorithms for filtering of signals with adaptive noises: (№1, 2, 3– SCOPUS); (№22, 23, 24, 25 - publications outside of SCOPUS); (№1, 2, 3, 5, 6 – training manuals and monograph).

3. General characteristics of the applicant's activity
3.1. Evaluation of the pedagogical preparation and activity of the applicant

Subjects list in which Dr. I. Balabanova conducts courses of bachelor's and master's lectures and practical courses is given, respectively: Communications circuits, Switching and multiplexing technique, Telecommunications transfer Lines, Electromagnetic compatibility, Signals and systems and Training practice.

The applicant has been academic advisor to 56 successful graduates which 38 bachelor and 18 master degree students.

At seminar and lab classes conducted, Chief Assist. Prof. I. Balabanova, Ph.D. participates in the elaboration of 7 laboratory exercises of which 1 dummy, 5 software products and one software technical system. A software system for "Investigation and Implementation of Digital Filters and Artificial Intelligence in TV Signal Quality" has been developed.

3.2. Evaluation of the scientific activity of the applicant

The applicant possesses a wide range of skills and technical tasks as well as solutions tools. Chief Assist. Prof. I. Balabanova is an active lecturer and researcher in the fields of telecommunications and optical communications, network technologies, communications circuits and processing, structure and composition evaluation of signals by neural networks, Principle component analysis, Fourier transforms, Gradient algorithms for training and pattern recognition, statistical processing, regression analysis and teletraffic modeling by predictive models, design of experiment and specific problems in optical communications.

4. Scientific, applied-scientific and applied contributions

- **Scientific contributions in monograph:**
  - ✓ An original system based on Feed-forward artificial neural networks with data preprocessing techniques (Principal component analysis and Fast Fourier Transform) and Levenberg-Marquardt and Scaled Conjugate Gradient training algorithms as well as ANFIS models for signal identification has been developed;
  - ✓ Classifiers with Gaussian and Kernel probability functions of input data have been created by Discriminant analysis and Bayes algorithm for additive noise classification in time and frequency domains;
  - ✓ Models for automatic recognition of communication signals in the presence of noise impacts with use of k - Nearest Neighbors and Decision tree methods are proposed. A methodology has been developed for statistical evaluation and noise level prediction in communication systems based on Regression analysis and Artificial neural networks.

- **Scientific and applied-scientific contributions in the field of telecommunications transfer lines and optical communications:**
  - ✓ **Scientific contributions in journal publication referenced in Web of Science (№1 - WoS):**
    - Regression techniques for statistical modeling and teletraffic parameters predictions have been designed.

- **Scientific contributions in papers indexed in SCOPUS (№ 4, 5, 6, 7):**
  - ✓ Neuro-fuzzy classifiers have been selected by hybrid and backpropagtion algorithms in training errors variety about teletraffic system $D+M+H_2+E_3/D/n/k$;
  - ✓ k-NN models with different metric distances and quality evaluation techniques have been analyzed and selected;
  - ✓ At variation of neurons in the hidden layers in artificial neural networks, Root-Mean-Square Error, classification accuracy and linear regression indicators are trained and examined. On the base of the analysis a neural architecture has been proposed.
  - ✓ Virtual tools have been created for statistical analysis and teletraffic flow evaluation in LabVIEW environment.

- **Applied-scientific contributions about publications in non-indexed journals (№ 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 26, 27):**
  - ✓ The transfer process of optical signals in high-speed fiber-optic systems is analyzed. The influence of the Hamming code distance over the quality characteristics of communication system was evaluated;
  - ✓ A statistical model has been made related to determine the probability of failure in spectral multiplexing networks as well as methodology about laser diode driver control;
  - ✓ The effect of modulation type and bandwidth of the TV channel have been investigated about the quality characteristics in TV cable networks;
  - ✓ The quality analysis of MPEG-encoded video images depend on packet loss and time-varying delays is made;
  - ✓ The application of artificial neural networks for evaluation of teletraffic loss systems based on the incoming traffic flows and the information channels;
  - ✓ k-NN, ANN and ANFIS models to determine the average standby time in teletraffic models of voice services ON/OFF+H/M/1/k are defined. Artificial neural networks have been synthesized regarding to teletraffic system $D+M+H_2+E_3/D/N/k$;
  - ✓ An algorithm for modeling of teletraffic system of voice service ON/OFF+H/M/1/k has been proposed. Predictive mathematical models for the average standby time in the system and the probability of losses are obtained by regression analysis;
  - ✓ Models for prediction the changes in Arrival Time and Exit System Time parameters have been proposed in design of experiment and regression analysis about QoS processes in Markov chain M/M/1/k;
  - ✓ A neuron system for Arrival and Start Execution Times determination in the server stations of Markov chains M/M/1 and M/M/1/k by teletraffic data processing.

- **Applied-scientific contributions in the field of communications circuits and filtering of signals with adaptive noises:**
  - ✓ **Applied-scientific contributions in papers indexed in SCOPUS (№ 1, 2, 3):**
  - - A web-based platform LabVIEW/MSSQL/MySQL has been developed for modeling and investigating of recursive and non-recursive filter groups, accumulation and storage of parametric and statistical data sets in relational database management systems;
  - - Multi-layer artificial neuron architectures and adaptive neuro-fuzzy interface systems are built in identification of electrical signals with presence of different additive noises.

  - ✓ **Applied-scientific contributions in non-indexed journals (№ 22, 23, 24, 25):**
  - - A virtual work environment for digital IIR filter modeling based on various types of approximation by application of artificial intelligence techniques has been developed;
  - - LabVIEW and MATLAB software methodology has been proposed about digital IIR and FIR filter design, signal observation and statistical data analysis;
  - - The project to QoS improvement in different television systems is realized by filter applications and Intelligent Data Mining for noise detection in carrier signals with different shape and distortion types. Various scenarios of multiple remote points from the global Internet network in real time have been considered and implemented.

5. Significance of contributions for science and practice

The contributions can be summarized as scientific confirmations of known facts and concepts as well as develop further of known methods and algorithms in the teletraffic and communication signal processing. The role and significance of the scientific results in education area and the implementation of new technical and technological solutions in the field of communications are undeniable.

6. Evaluation of candidate's personal contribution

A list of publications with 5 independent publications and 31 publications presented whose thematic relation in the scientific field of the individual papers gives grounds to confirm that the contribution of the candidate in collective works is high significant.

7. Critical notes and recommendations

About the scientific works for participation in the competition, the remarks according to the style of exposition and the terminological correctness such as "spectral signal",, "spectrum of signal", "optimization by level of information streams,… related to signals with reflected presence ..." can be mentioned. The remarks made do not affect of the overall good impression of the materials which are presented at the competition.

8. Personal impressions

Dr. I. Balabanova is a well-established teacher, specialist in the field of communications with the potential to develop and implement her scientific ideas in education and technologies.

9. Conclusion:

With regard to what has been stated above I propose Chief Assistant Professor Ivelina Stefanova Balabanova, Ph.D. to be awarded the academic position of "Associate Professor" in the area of higher education - 5. Technical Sciences, professional field – 5.3. Communication and Computer Engineering; scientific specialty: "Communication Networks and Systems" (Communications circuits, Telecommunications transfer lines).

/signature/

19.10.2019 y.

Jury member: / Prof. D.Sc. A. D. Lazarov /