OPINION

by Assoc. Prof. Simeon Aleksandrov Ribagin, PhD

Institute of Biophysics and Biomedical Engineering - BAS

As a member of the Scientific Board of the announced competition, by Director's Order
№ 1349/14.10.2024 of the Institute of Biophysics and Biomedical Engineering - BAS

Regarding: Competition for academic position "associate professor" in 5. Technical sciences",
professional direction 5.2. "Electrical engineering, electronics and automation (Application of the
principles and methods of cybernetics in various fields of science (biomedicine)) for the needs of
the "Processing and analysis of biomedical signals and data" department, published in the State
Gazette, issue 69/16.08.2024.

One candidate, senior assist. prof. Dr. Todor Venkov Stoyanov, is currently taking part in the
competition for the academic position of " associate professor ". The submitted documents have
been prepared in accordance with the requirements of the Law for the Development of the
Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for its implementation,
as well as the regulations for the conditions and the procedure for acquiring academic degrees and
occupying academic positions in the Institute of Biophysics and Biomedical Engineering - BAS.

Brief biographical background and professional experience of the candidate:

Dr. Stoyanov was born in 1972 in the city of Sofia. He graduated from the Technical School of
Energy - Sofia in 1992. He acquired his Master Degree in "Faculty of electronics, TU "Sofia
София", Faculty – FETT., in 1999 and in 2005 he obtained his PhD degree in scientific discipline
Informatics at the Institute of Biomedical Engineering –BAS with the dissertation thesis:
"Computer processing and analysis of electrocardiograms". His professional career, started in
2003 as an assistant professor at the Central Laboratory of Biomedical Engineering – BAS. In
2005, he was elected " senior assistant. professor " at the Institute of Biophysics and Biomedical
Engineering (IBPhBME) - BAS. Currently, Dr. Stoyanov is a member of the "Processing and
Analysis of Biomedical Signals and Data" department at IBPhBME - BAS. Since 2000, he began
his academic activity in "Faculty of electronics, TU Sofia, leading master's exercises "Biomedical
Engineering". In the period 2000-2006 he supervised 5 graduates in "Faculty of electronics, TU
Sofia. Dr. Stoyanov's scientific interests are in the fields of: Mathematical processing and analysis
of biomedical signals, digital filtration, detection and classification of chamber complexes, real-
time operating systems, application programming for "Small" microprocessor systems, hardware
and software design and construction of microcontroller systems, independent galvanic isolated
modules for recording ECG and other signals, scripting for database management, etc.

The biographical information presents the candidate as a proven scientist with clearly expressed
scientific interests in the professional field of the current competition procedure, which fully
justifies the requested participation of the candidate.

In the current competition for the academic position of " associate professor ", the applicant
participates in a total of 36 scientific publications, 2 of which were independent, and the remaining
34 were collective works, he is a sole author of 1 and a first author of 5. Of these, 8 are articles in

journals with an impact factor with a total IF = 25.29. The candidate's participation in 6 research projects is evident from the presented materials. At the moment, over 300 citations of the candidate are known, as the h-index calculated by Scopus, excluding self-citations by all co-authors, is 8.

Based on the presented documents, his research is focused on the study of several scientific fields. Depending on the subject of study, contributions can be divided into the following main groups:

1. **Development of devices - prototypes for registration, calibration and testing** (Г8.2, Г8.15, Г8.9, Г7.2, Г8.10).). Significant scientific-applied and applied contributions here are the development of 4 prototype devices, as well as the development of a new standard for checking digital electrocardiographs, which is a prerequisite for the implementation of new methods for digital processing of biomedical signals.

2. **Development of methods for EMG signal filtering** (Г7.3, Г8.14, Г7.7, Г8.3, Г8.8, Г8.11). The candidate's research in this direction is expressed in the development of low-frequency filters (LFF) for suppressing high-frequency noise and, in particular, EMG interference, as well as filters for suppressing network interference with a frequency of 50-60 Hz. The publications make a significant contribution to solving one of the main tasks in biosignal analysis, namely, the filtering of electromyographic (EMG) disturbances, while at the same time they can serve for the development and implementation of new filters for biomedical signal processing,

3. **Detection of P-waves and segmentation of cardiac cycles** (B4.11) In this direction, the application of trained and tested neural network models for segmentation of an averaged PQRST segment is applied.

4. **Detection of cardiac arrhythmias** (Г8.4, Г8.5, B4.1, B4.2, B4.3, B4.4, B4.6, B4.8, Г8.6, Г8.7, Г8.1, Г8.14). The main scientific-applied and applied contributions can be mentioned here:
   - The development of a system for decision making regarding the need to apply defibrillation with a minimum delay after the end of cardiac massage;
   - Evidence that AEDs with adult settings can be used effectively in childrens;
   - The development of algorithms for the detection of life-threatening arrhythmias, which analyze short ECG segments without artifacts;
   - The calculation of a set of 118 criteria characterizing single-channel ECG signals in the time and frequency domain;
   - The implementation of classification of single-channel ECG signals in 4 classes - atrial fibrillation, normal sinus rhythm, other arrhythmias and highly noisy signals;
   - The development of an algorithm for pre-procedural risk assessment of atrial fibrillation recurrence after catheter ablation;
   - The application of a new approach to the analysis of high-resolution ECG recordings to assess the size and localization of acute myocardial infarction.

5. **Development of software for annotating ECG signals dysfunctions** (Г7.10). The main applied contributions of the candidate in this direction are related to the possibility of using the developed software for annotating large ECG databases, without limitation of the number of channels and the duration of recordings.

6. **Intuitionistic fuzzy sets, intercriteria analysis and generalized nets – theory and applications in medicine** ((В4.10, Г7.5, Г8.13, Г8.12, Г7.9, Г7.1, Г7.4). Necessary and sufficient conditions have been established in the scientific researches for the conversion of partial inclusion into the classic inclusion of IRM, the theory of IRM has also been expanded by introducing new regulations over IRM. In addition, the study of non-linear relationships between criteria calculated in the processing of ECG signals for the purpose of detection of cardiac arrhythmias and the creation of models for the design and construction of centers for remote medical care is a serious contribution of the candidate.

Contributions in scientific works and studies of the candidate can be defined as original with high scientific and practical significance.

The materials presented by Dr. Stoyanov meet and exceed the requirements for occupying the academic position of "associate professor" according to the Low for the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), as well as the regulations specified in Annex №1,2 for the conditions and the procedure for acquiring academic degrees and occupying academic positions in the Institute of Biophysics and Biomedical Engineering - BAS, in the scientific field 5. Technical sciences, as following:

- Criteria A: 50 points
- Criteria B: 130.5 points
- Criteria C: 244 points
- Criteria D: 100 points

The total sum of the points of the participant is **524.5** and the minumum required amount of points for the academic position of "associate professor" in in the scientific field 5. Technical sciences is **400** points.

Conclusion

The documents and materials presented at the competition show convincingly the valuable scientific achievements of Dr. Stoyanov. The scientific indicators fully responded to the law and requirements for the occupation of the academic position "associate professor" in the Institute of Biophysics and Biomedical Engineering - BAS. The above gives me a reason to assess **positively** the candidature of Dr. Stoyanov and to recommend to the members of Scientific Jury to prepare a report-proposal to the Scientific Council of the Institute of Biophysics and Biomedical Engineering – BAS for the election of senior assist. prof. **Dr. Todor Venkov Stoyanov** as **"Associate professor"** in the scientific Technical sciences", professional direction 5.2. "Electrical engineering, electronics and automation (Application of the principles and methods of cybernetics in various fields of science (biomedicine))

20.11.2024   **Member of the Scientific Board**

/ Assoc. Prof. Simeon Aleksandrov Ribagin, PhD/