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REVIEW

In a competition for the academic position of "professor",

announced by the Institute of Robotics at BAS-Sofia in SG No. 26 page 34/March 21, 2023, for the needs of the section "Sensors and measurement technologies in robotics and mechatronics (magnetic field sensors)"

in professional field 5.2. Electrical engineering, electronics and automation (Sensors for magnetic field),

with a single candidate Assoc. Prof. Ph.D. August Yordanov Ivanov

Reviewer: Prof. Dr. Ivan Borisov Evstatiev, Ruse University "Angel Kanchev", Ruse.

1. GENERAL DESCRIPTION OF SUBMITTED MATERIALS

The materials of Prof. Dr. August Ivanov are arranged and presented according to the requirements for the fulfillment of the Scientific criteria for acquiring scientific degrees and holding academic positions.

The scientific works in the competition for the title professor include 30 publications, of which 26 are indexed in Scopus and/or Web of Science, 20 of them are with IF or SJR, 2 are in Q1 journal and 1 – in Q4 journal. From the works indexed in Scopus and/or in Web of Science, the candidate has presented 10 publications equivalent to a monographic work under the general title "New generation of multipurpose sensor elements".

It should be noted that in addition to 10 publications equivalent to a monographic work, the same topic was also worked on in the presented 4 patents, 1 publication accepted for publication and 1 report on the contribution of the Institute of Robotics to the BAS, included in the BAS Report to the National Assembly for 2022.

For participation in the competition for a professor outside the publications equivalent to a monographic work, for fulfilling the requirements of the scientific criteria for acquiring scientific degrees and occupying academic positions, 47 works are included, of which the works indexed in Scopus and/or Web of Science are 16, in non-indexed conferences there are 2, of which 1 has been accepted for publication, recognized patents for inventions are 22 and filed applications for inventions - 7. Patents and applications for inventions are presented in a list of 29 items. All of them have been recognized as inventions or filed as invention applications in the last 5 years.

The candidate has also presented a list of participation in "Research projects and contracts, technology transfer", which includes 42 projects, of which 37 are under the operational program "Science and education for intelligent growth" priority axis 1 "Research and technological development" procedure BG05M20P001-1.002, and 5 were financed by EU structural funds under the Operational Program "Innovation and Competitiveness". Of these 42 projects, 12 have been cited for the fulfillment of the scientific criteria for acquiring scientific degrees and occupying academic positions, and in 2 of them the candidate is a leader, and in 10 he is a participant in the collectives.

In one of the projects led by Prof. Ivanov, 1 100 000 BGN were attracted.

The citation reference includes a total of 50 citations, of which 36 are in scientific publications, referenced and indexed in world-renowned scientific information databases (SCOPUS and/or Web of Science), of which 7 are in Q1 journals, 21 are in Q2, 2 are in Q3 and 1 is in Q4.

A list of 9 awards and participations in national and international forums is presented, as well as a report on the fulfillment of the minimum required points by groups of indicators for the academic position of professor, according to the requirements for the fulfillment of the scientific criteria for acquiring scientific degrees and occupying academic positions.

The works, other than those submitted for the competition for professor, are for participation in the competition for associate professor (41, of which 12 are equivalent to a monographic work) and related to the dissertation work (6, of which 2 are patents).

2. BRIEF BIOGRAPHICAL DATA

Assoc. Prof. August Ivanov completed his secondary education at "Hristo Botev" High School - Sofia, majoring in mathematics, physics and programming. He then went on to become an engineer-master in "Hydraulics and Pneumatics" at the Technical University - Sofia, FET faculty. He specializes in "Mechanical systems in robotics" at the Technical University - Sofia.

He is a doctor since 2017. The topic of the dissertation is "New varieties of magnetic field microsensors using Hall effect".

Prof. Ivanov's professional career began in 1985, as a design engineer at the Institute of Technical Cybernetics and Robotics at the BAS in the "Robots and Manipulators - Hydraulic Drive of Industrial Robots" section. In 1992 he became a design engineer at the Institute of Informatics at the BAS in the section "Pneumatic and hydraulic drives and control of robots and manipulators, administration of local computer networks".

In 1994 Assoc. Prof. Ivanov holds the position of assistant at the Institute of Management and System Studies at the BAS, since 2000 is a chief assistant at the Institute of System Engineering and Robotics at the BAS, and since 2017 until now he is an associate professor at the Institute of Robotics at the BAS.

The candidate is a member of the following international and national professional scientific associations, committees, federations, societies, etc.:

-Secretary of the Bulgarian section in the International Network of Multifunctional Microsystems NEXUS Network of Excellence;

-membership and management of Organization and Program Committees of international and national conferences, symposia, round tables, seminars, etc., such as EUROSENSORS, TRANSDUCERS, SENSORS;

- The Federation of Scientific and Technical Unions;

- The Union of Scientists in Bulgaria;

- The Bulgarian Robotics Society;

- The Union of Mathematicians in Bulgaria;

- the editorial board of "Complex Control Systems", ISSN 1310-8255;

- the editorial board of the Scientific journal "Problems of Engineering Cybernetics and Robotics" PRINT ISSN: 2738-7356 ONLINE ISSN: 2738-7364.

GENERAL CHARACTERISTICS OF THE CANDIDATE'S ACTIVITY 3. EDUCATIONAL AND PEDAGOGICAL ACTIVITY

According to the presented documents and references, as achievements of Assoc. Prof. Ivanov in the field of educational and pedagogical activity, participation in projects for "E-learning - concepts, tools for development and implementation" of IUSI-BAS, and "Software for remote training, simulation and management in robotics" of IUSI-BAS. It is also worth noting the rich administrative and managerial experience, as well as membership in commissions of the Ministry of Education and Culture and governing bodies of BAS. The candidate was the deputy. Chairman of the Innovation Council of IR-BAS, and since 2018. until now Assoc. prof. Ivanov is the Director of IR-BAS.

Prof. Ivanov is a member of the following commissions of the Ministry of Education and Culture and governing bodies of BAS:

-Commission for cooperation with CERN at the Ministry of Education and Science;

- OS of BAS;

- KAS - Academic Property Commission at the BAS;

- SSS - Council for Social Cooperation of the BAS;

- NS of IR-BAS.

I believe that the educational and pedagogical activity of Assoc. Prof. Dr. August Ivanov fully meets the necessary requirements for the disclosure of a procedure for a professor.

4. SCIENTIFIC AND SCIENTIFIC-APPLIED ACTIVITY

It follows from the presented materials that the candidate's research and applied activity is mainly related to the creation, research and application of sensors and sensor elements.

A significant part of the publications is related to the topics of the scientific research projects, which confirms the scientific and scientific-applied nature of the developments of Assoc. Prof. Ivanov.

It should be noted that for the last 5 years, Associate Professor August Ivanov is a co-author in the created 29 patents, of which 22 have been recognized, and the remaining 7 are applications.

I want to emphasize that the subject of his scientific and scientificapplied activity is extremely relevant, due to the importance of the creation and use in technology of sensors for control and management of various processes.

5. IMPLEMENTATION ACTIVITY

The implementation activity is represented by participation in 42 "Scientificresearch projects and contracts, technology transfer". Of these, 37 are under the operational program "Science and education for intelligent growth", priority axis 1 "Research and technological development", procedure BG05M20P001-1.002 projects, and 5 are financed by EU structural funds under the operational program "Innovations and competitiveness ".

The candidate was the head, coordinator and co-head of 4 research projects.

It should be noted that 25 of the topics of the projects completely coincide with the topics of the candidate's research activity. Funds worth BGN 1,100,000 were attracted for one of the projects managed by the candidate.

The candidate has co-authored 29 patents and patent applications submitted in the professorship.

The economic effect of the implementation of these developments in practice is undoubted.

6. BASIC SCIENTIFIC AND SCIENTIFIC-APPLIED CONTRIBUTIONS

I agree with the author's view on contributions. They are scientific, scientificapplied and applied.

A. Contributions in the presented publications, equivalent to a monographic work under the general title "New generation of multi-purpose sensor elements"

I believe that in the presented publications, equivalent to a monographic work, there are scientific, scientific-applied and applied contributions. They could be summarized as follows:

Scientific contributions

Creation of methodological conditions of targeted scientific and applied research on "New generation sensor elements with multifunctional purpose", contributing to the expansion of existing knowledge in the field of sensors and, above all, magnetometry and galvanomagnetism through new facts, mechanisms of operation, methods for their characterization and applicability. The new sensor elements created are based on new principles and have no analogue in control and measurement technology.

Scientific and applied contributions

Contributions of a scientific and applied nature can be summarized in the following form:

1. Establishing a hitherto unknown regularity in sensorics, consisting in the occurrence of a linear potential from the magnetic field on one side of the Hall elements, and a nonlinear one on the opposite surface, allowing the creation of a new generation of high-precision 2-D and 3-D magnetometers with applicability in robotics and metrology [3.2. Reference: 2, 3, 4, 11, 12, 13].

2. Experimentally investigated and theoretically interpreted a new regularity in the magnetoelectric properties of the surface of conductive materials, including semiconductors, which consists in controlling through the strength and direction of the magnetic field the scattering of current carriers by changing their concentration in the near-surface layers, allowing the creation of multifunctional sensors modules in robotics and robotic medicine, quantum communication, navigation, counter-terrorism, warfare, and more. [3.2. Reference: 5, 7, 8].

3. The phenomenon "Emission of particles under uniaxial pressure of solid structures" was discovered and interpreted, and a previously unknown regularity was established in the inhomogeneous systems - rocks and concrete, resulting in the generation of microparticles under the influence of high uniaxial deformations, enabling the creation of monitoring for early disclosure and prediction of pre-emergency and emergency events in critical infrastructure [3.2. Reference: 15, 16].

Applied Contributions

1. Creation of a family of multidimensional silicon microsystems for measuring the magnetic field without analogue in control and measurement technology, characterized by a maximally simplified design, high spatial resolution, removed influence of parasitic disturbances and significant sensitivity [3.2. Reference: 6, 9].

2. Experimental study of the magnetically controlled surface current in Hall sensors with in-plane and orthogonal magnetosensitivity, proving that the Hall voltage consists of two components summing additively, increasing the knowledge of the Hall mechanism [3.2. Reference: 1, 14].

3. Creation of a generator for charging a battery module intended for sensors and electronic devices with low consumption, working with a radio range transferring digital data for the identification of moving objects, consisting of a movable permanent magnet, moving when the object moves and generating electromotive voltage in a multilayer induction coil [3.2.Reference: 10].

B. Contributions to publications other than those equivalent to monographic work

Scientific contributions

1. A new sensor mechanism in Hall microsystems was discovered, studied and interpreted, allowing by injection of non-main carriers with only 0.1% of the

supply current to increase the magnetosensitivity by more than 50% [3.1. Reference: 8, 9].

2. Essentially new aspects of the Hall effect were substantiated and proved, usefully increasing the knowledge of this phenomenon, consisting in: a) the additional current carriers from the Lorentz force on the corresponding boundary surface are mobile, and not statically located as it was considered until now and determine the surface current; b) the potentials and the Hall voltage are generated both by the different density of surface charges forming the Hall electric field from the deflected electrons on one side and from the uncompensated positive donor ions on the opposite side, as well as by the additional voltage drop on the opposite interfaces from the flow of the magnetically controlled surface currents [3.1. Reference: 29, 30, 31, 32, 33, 34].

The scientific contributions are related to the enrichment of knowledge in the field of the development of sensors and multidimensional magnetometry.

Scientific and applied contributions

Scientifically applied contributions can be summarized as follows:

1. A method for measuring more than one non-electrical parameter – magnetic field and temperature – with the same area in silicon structures has been developed and tested. The basis of the action of the new multisensors is the amperometric principle. High sensitivity, substantial resolution and improved signal-to-noise ratio have been achieved [3.1.Ref: 1, 2, 3, 4].

2. It has been established experimentally in sensor electronics the occurrence in conductive structures, including semiconductors, in a wide temperature range of a magnetically controlled surface current, when a supply current is passed through the structures and a magnetic field is applied perpendicular to it. The surface current depends linearly on both the magnetic field strength and the supply current, and its direction reverses if one of these inputs changes polarity. The new regularity is strongly expressed and is registered on the side surfaces of samples on which the Hall voltage is generated [3.1. Reference: 10, 11, 12, 13, 14].

3. A theoretical model was developed, interpreting the experimental results of the discovered regularities - magnetically controlled surface current in conductive materials and anomalies in the behavior of the potentials of semiconductor structures in a magnetic field. The existing contradictions in the interpretation of the classical and quantum Hall effect have been removed by expanding the scope of their applicability. Based on them, an innovative method was formulated and proven, containing three mutually complementary methods for studying the surface quality in semiconductors [3.1. Reference: 21, 22, 23, 24, 25, 26, 27, 28].

Applied Contributions

1. New three-component (3-D) vector magnetometers have been designed, implemented and tested using the functional integration of Hall microsensors with parallel and orthogonal axis of sensitivity, measuring simultaneously and independently the three spatial components of the magnetic field. New 3-D sensors are promising for precise scanning of the magnetic field topology and its spatial gradient above all in microbiological systems containing magnetic nanoparticles such as blood, blood plasma, etc. [3.1. Reference: 5, 6, 7].

2. A family of multidimensional silicon vector magnetometers has been developed, containing a minimum number of contacts, registering simultaneously and independently the 2D and 3D components of the magnetic field [3.1. Reference: 15, 16, 17, 18, 19, 20].

I believe that the scientific, applied scientific and applied contributions in the discovery materials for the professor procedure are extremely important for the development of modern theory for the development and control of sensors and multidimensional magnetometry and their application in technology.

7. SIGNIFICANCE OF CONTRIBUTIONS TO SCIENCE AND PRACTICE

From the candidate's contributions, it can be concluded that they have a scientific, scientific-applied and applied nature and that they are subordinate to an extremely important topic for science and technology - the construction of sensors necessary for modern control and management systems in fields different for modern technology such as electronics, electrical engineering, robotics, medicine, etc.

I would say that the contributions are at the level of scientific discoveries in the field of sensors. This is confirmed by 22 recognized patents and 7 more applications filed in the last 5 years.

On a global scale and in Bulgaria, Assoc. Prof. Ivanov is known to the scientific community. For confirmation, the publications referenced in SCOPUS and/or Web of Science, with IF and SJR, in journals with Q1 and Q4, as well as 50 citations, of which 36 are in scientific publications, referenced and indexed in world-renowned databases.

8. ASSESSMENT OF THE CANDIDATE'S PERSONAL CONTRIBUTION

In terms of personal contribution, the applicant's materials confirm what can be achieved in teamwork - discoveries, patents, projects, publications in highly reputable conferences and journals. The quantitative indicators are 30 publications, 22 recognized patents and 7 applied for, 42 projects with participation and leadership on the subjects of the publications and patents, attraction of funds worth BGN 1,100,000 for a project led by the candidate.

Considering this information, it can be confidently asserted that the personal contribution of Assoc. Prof. Dr. August Ivanov in the presented production is beyond any doubt.

9. CRITICAL NOTES AND RECOMMENDATIONS

I have no critical notes. In the further activity of the candidate, I would recommend that he keep the following in mind.

To direct attention to a more widespread implementation in practice of the applicant's impressive discoveries and developments, considering that they are extremely important to the industry related to the creation of new sensors and their application in technology.

10. PERSONAL IMPRESSIONS

The applicant's publication, invention and innovation activities are impressive. I would note the connection between research, publications and patenting. The fact that part of the research activity of Prof. August Ivanov is related to the discovery of new properties of semiconductors and their application in the creation of sensors also makes an impression.

I think that as a scientist, specialist and leader, he possesses remarkable qualities. With the successful completion of this procedure, the Institute of Robotics at BAS-Sofia will be enriched with a possible excellently prepared specialist, researcher, implementer and organizer. 11. Fulfillment of the requirements of NACID to meet the minimum national requirements under Art. 2b, para. 2 and 3, respectively, to the requirements under Art. 2b, para. 5 of ZRASRB, designated in PPZRASRB for the academic position of professor in professional direction 5.2. Electrical engineering, electronics and automation

The publication and scientific activity of the candidate for the opening of a procedure for a professorship in the professional direction 5.2.Electrical engineering, electronics and automation (Sensors for magnetic field), at the Institute of Robotics at BAS-Sofia for Assoc. Prof. Dr. Eng. August Yordanov Ivanov fully cover and for some of the points they significantly exceed the requirements for the academic position of professor.

12. Conclusion

The presence of publications equivalent to a monographic work, the publications outside of them, the scientific research, inventive, applied, implementing and organizational activities, the wide fame in our country and abroad give me the reason to propose Assoc. Ph.D. Eng. August Yordanov Ivanov to occupy the academic position of "professor" in the professional field: 5.2. Electrical engineering, electronics and automation, section "Sensors and measuring technologies in robotics and mechatronics (magnetic field sensors), for the needs of the Institute of Robotics at BAS-Sofia.

June 30, 2023 Ruse

Reviewer: /Prof. I. Evstatiev/