# O P I N I O N

## on the competition for occupying an academic position of Associate Professor in professional strand of "4.6 Informatics and Computer Sciences (Image Processing)" for the needs of the Information Technologies and Sensor Data Processing Section, Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences published in the Bulgarian State Gazette No. 68 / 31.07.2020

Applicant: **Dimiter Petkov Prodanov, PhD**

Jury member: **Assoc. Prof. George Vasilev Angelov, PhD**

### *1. General Characteristic of the Research and Applied Activity of the Applicant*

The applicant has research and application activities in the following three fields:

- **Neuroinformatics frameworks for signal processing and data analysis**

Neuroinformatics is a new research and applied field that is based on the achievements of applied mathematics, computer and engineering sciences.

The applicant's research in this field is focused on image processing in microscopy, segmentation, quantitative analysis of morphological structures and information systems for analysis of quantitative data.
In this field the applicant has published 5 papers, including 3 in journals with Impact Factor (IF), 1 chapter in a monograph as well as several demonstrations and 7 scientific letters.

1. Prodanov D. Data ontology and an information system realization for web-based management of image measurements. Frontiers Neuroinform. 5:25, 2011, ISSN 1662-5196, DOI: 10.3389/fninf.2011.00025
2. Prodanov D & HKP Feirabend, Automated characterization of nerve fibers labelled fluorescently: determination of size, class and spatial distribution. Brain Research, 1233: 35-50. 2008, ISSN: 0006-8993 DOI: 10.1016/j.brainres.2008.07.049

3. Prodanov D & HKP Feirabend, Automated characterization of nerve fibers labelled fluorescently: determination of size, class and spatial distribution. Brain Research, 1233: 35-50. 2008, ISSN: 0006-8993 DOI: 10.1016/j.brainres.2008.07.049
4. Micholt L, Gartner A, Prodanov D, Braeken D, Dotti CG, Bartic C. Substrate topography determines neuronal polarization and growth in vitro. PLoS One. 2013 8(6):e66170. DOI: 10.1371/journal.pone.0066170, ISSN 1932-6203
5. D Prodanov, Konopczynski T, Trojnar M, Selected Applications of Scale Spaces in Microscopic Image Analysis, CIIT, 15 (7):5-12, 2015, 10.1515/cait-2015-0084, ISSN 1314-4081
6. T. Dumur, S. Duncan, K. Graumann, S. Desset, R. S Randall, O. M. Scheid, H. W Bass, D. Prodanov, Christophe Tatout & Célia Baroux (2019) Probing the 3D architecture of the plant nucleus with microscopy approaches: challenges and solutions, Nucleus, 10:1, 181-212, DOI: 10.1080/19491034.2019.1644592

The field is topical in the context of European Scientific Infrastructure and European Data Cloud. The applicant is a recognized expert in image analysis for biomedical and bioapplications as it can be seen by the review papers and chapters in monographs. Some research and development activities are funded by Google's INCF (International Neuroinformatics Coordinating Facility) network. Some research letters are invited by prestigious research forums in neurosciences, e.g. FENS (Federation of European Neuroscience Societies) Forum.

- **Algebraic tools enabling computational biology**

Computational biology is a new field empowered by the achievements of mathematical modeling in physics and chemistry. As opposed to the traditional descriptive and empirical approach of biological sciences, computational biology develops quantitative analytical or mechanic models.

In this field the applicant has published 3 papers in journals including 2 with IF, 1 – with Q1 rank and 1 – with Q2 rank.

1. Prodanov D, Clifford Algebra Implementations in Maxima, Journal of Geometry and Symmetry in Physics 43, 73-105, 2, 2017, ISSN 1312-5192,
2. Prodanov, D., Toth, V.T. Sparse Representations of Clifford and Tensor Algebras in Maxima. Adv. Appl. Clifford Algebras 27, 661–683 (2017). DOI: 10.1007/s00006-016-0682-x, ISSN 1661-4909
3. Prodanov D, Delbeke J, A model of space-fractional-order diffusion in the glial scar, Journal Theoretical Biology, 403(21): 97-109, 2016, ISSN 0022-5193, DOI: 10.1016/j.jtbi.2016.04.031

The applicant's research in this field is focused on development of models for cell migration and diffusion of leachable substances around an implant. In applied aspect the applicant has developed a package for computations with Clifford algebras in Maxima that enable visualization of geometry objects, coordinate transformations, Green function extraction from Poisson's equation and variational problems.

The field is topical – computer algebraic methods enable analytical solutions and asymptotic solutions that significantly improve the understanding of the biological phenomena. The applicant gives an example with the anomalous diffusion problem studied in Prodanov D, Delbeke 2016 – the fractional calculus approach enables greater flexibility in describing real data with integral fractional exponents.

- **Neural prosthetics and neural plasticity of the Central Nervous System**

This field includes papers that are a direct continuation of the applicant's PhD thesis or that are related to the BrainSTaR project led by the applicant in the period 2013-2014. The subject-matter includes wide research efforts in big research teams.

In this field the applicant has published 3 papers in journals with IF, 2 chapters in scientific monographs and 3 short scientific letters.

1. Welkenhuysen M, I. Gligorijevic, L. Ameye, D. Prodanov, S. Van Huffel & B. Nuttin, Neuronal activity in the bed nucleus of the stria terminalis in a rat model for obsessive-compulsive disorder. Behavioural Brain Research, 240:52-9 2013. ISSN : 0166-4328; DOI: 10.1016/j.bbr.2012.11.019
2. Mora Lopez C, D Prodanov, D Braeken, I Gligorijevic, W Eberle, C Bartic, R Puers & G Gielen. A Multichannel Integrated Circuit for Electrical Recording of Neural Activity, With Independent Channel Programmability, IEEE Transactions on Biomedical Circuits and Systems, 6(2). 101-110. 2012; ISSN: DOI: 10.1109/TBCAS.2011.2181842.
3. Prodanov D, G Mantchev, A Iliev., V Traykov, R Kaneva, K Yakimova, & I Krushkov, Effects of dexamethasone in rat neonatal model of axotomy-induced motoneuronal cell death. Arch Physiol Biochem, 106(5), 355-361, 1998

Monograph Chapters

1. Braeken D and D. Prodanov. New trends and challenges in the development of microfabricated probes for recording and stimulation of excitable cells, In D Campolo (ed), "New Developments in Biomedical Engineering", pp 311 – 339. In-Tech, Vukovar, 2010. ISBN 978-953-7619-57-2; DOI: 10.5772/7613

2. Prodanov D., M. Welkenhuysen, S. Musa, W. Eberle, T. Dresselaers, U. Himmelreich, C. Bartic, G. Borghs, B. Nuttin. Functional evaluation of a micro-fabricated planar multielectrode probe for in vivo neuronal recording. In: Dössel O., Schlegel W.C. (eds), "World Congress on Medical Physics and Biomedical Engineering, September 7 - 12, 2009, Munich, Germany. IFMBE Proceedings, vol 25/9". Springer, Berlin, Heidelberg. DOI:10.1007/978-3-642-03889-1_64; ISBN 978-3-642-03888-4

The applicant's work exceeds the minimum requirements. Below described are just the indicators backed up with documents.

In *Group B* are given papers under Indicator *"4. Habilitation work – scientific publications in editions that are references and indexed in well-known world data bases (Web of Science, Scopus, Zentralblatt, MathSciNet, ACM Digital Library, IEEE Xplore u AIS eLibrary)"* – 3 papers including 1 single-author paper – all amounting to 150 points with the minimum number of 100 points.
All the 3 papers are published in prestigious journals with Q1 rank. Two papers are in the field of "Neuroinformatics frameworks for signal processing and data analysis", and one in the field of "Algebraic tools enabling computational biology".

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| P2016B | Prodanov D, Delbeke J, A model of space-fractional-order diffusion in the glial scar, Journal Theoretical Biology, 403(21): 97-109, 2016, ISSN 0022-5193, DOI: 10.1016/j.jtbi.2016.04.031 | Pubmed, Web of Science | IF 2.116 (2016) | Q1 | 50 |
| M2013B | Micholt L, Gartner A, Prodanov D, Braeken D, Dotti CG, Bartic C. Substrate topography determines neuronal polarization and growth in vitro. PLoS One. 2013 8(6):e66170. DOI: 10.1371/journal.pone.0066170, ISSN 1932-6203 | Pubmed, Web of Science | IF 3.534 (2013) | Q1 | 50 |
| P2011B | Prodanov D. Data ontology and an information system realization for web-based management of image measurements. Frontiers in Neuroinformatics. 5:25, 2011, ISSN 1662-5196, DOI: 10.3389/fninf.2011.00025 | Pubmed, Web of Science | IF 3.261 (2014) | Q1 | 50 |

In *Group Г* are given papers under Indicator *"7. Scientific publication in editions that are referenced and indexed in well-known world data bases with scientific information"* – 11 papers, 298 point in total with the minimum number of 260 points, as well as 3 chapters under Indicator *"8. Published chapter in book or collective monograph"* .

These publications are duly attached to the applicant's documentation in "List of copies of the presented publications in referenced journals with scientific review (Г8)".

In *Group Д* are given papers under Indicator "12. Citations or reviews in scientific editions referenced and indexed in well-known world data bases with scientific information in monographs and collective volumes" – 876 points.

## *2. Main scientific and applied contributions*

The applicant participates in a number of international teams and projects. Main projects in this field are the post-doctoral competition to IBRO, the applied BrainSTaR project as well as the joint project between BAS and FWO. The applicant has not provided the amount of the funding.

I do accept the listed contributions as scientific, applied-scientific, and applied. I do consider that they can be generalized as follows:

Applied

- Development of information system LabIS and ontology that is used in some of the applicant's papers
- Development of Miji interface between ImageJ and MATLAB that now is a standard component in the Fiji package for image analysis

Applied-scientific

- Development of applications for ImageJ – 5 pcs.
- Development of system for image segmentation for ImageJ
- 2 packages to the Maxima system for Clifford algebras
- Development of template-less algorithm for digital signal decomposition
- Development of algorithm for transient and frequency analysis method – ML2012G

Scientific

- Development of methodology for nerve-fibers' classification in microscope images – P2008B.
- Development of spatial statistical model for distribution of synapse proteins in axons – M2013B.
- Development of cell migration model and diffusion of leachable substances around an implant

## *3. Significance of the contributions to science and practice*

From the expose of the record and after detailed familiarizing with the scientific production it can be seen that the scientific, applied-scientific, and the applied contributions in the works of Dr. Dimiter Prodanov are characterized with significance in the field of neuroinformatics, computational biology algebraic tools, neural prosthetics and neural plasticity of the Central Nervous System. This significance is reasoned by novel ideas, serious mathematical and biological justification, practical applicability in scientific developments and research project.
The research is carried out in the prestigious Belgian universities and world-know research center of IMEC.

## *4. Critical remarks and recommendation*

The overall formatting of the summary is very good, the style and terms are correct, in complete compliance to actual status in the fields. For these reasons, below are listed the following deficiencies and inaccuracies are identified:
- it would be better for the contributions, classified in the record as scientific, applied-scientific, and applied, to be synthesized in order to focus the reviewers to their substance
- in the record it is desirable to focus, where applicable, on a more detailed comparison to existing scientific developments and publication
Decent recommendation could be made to Dr. Dimiter Prodanov as well as wished for even better theoretical studies, leadership and participation in new scientific projects and more beneficial publication activity.

## *5. Personal impressions*

I do know Dr. Dimiter Prodanov from about 10 years as a specialist in IMEC. I am aware with his scientific and project activities based on his journal and scientific forum activities as well as based on conversations and discussion in a collegial manner on topics of mutual research interests.

## *CONCLUSION*

The above expose, the summarized results and contributions plus the publications give me sound reasons to note that the presented documentation meets the requirements of the Regulation for the Conditions and Procedures for Occupying Academic Positions in IICT-BAS for the occupation of the academic position of Associate Professor.

I believe that the applicant should be elected for the academic position of Associate Professor.

01.12.2020
Sofia

Jury member:



/Assoc. Prof. George Angelov, PhD/