

REVIEW

**for the competition for occupation of the academic position „professor”
in the professional field 5.2. Electrical engineering, electronics and automatics, the
scientific specialty „Application of principles and methods of cybernetics in various fields
of science (technical)“, declared in the State Gazette № 95/14.11.2023 for the needs of
Department of Intelligent Systems at the Institute of Information and Communication
Technologies-Bulgarian Academy of Sciences, with the only candidate:
Assoc. Prof. PhD Vera Angelova Angelova-Dimitrova**

**Member of the scientific Jury: Prof. PhD Eng. Alexandra Ivanova Grancharova
University of Chemical Technology and Metallurgy-Sofia, Department of Industrial
Automation**

I present this review as a member of the scientific Jury of the above mentioned competition on the base of order №7 from 10.01.2024 of the Director of the Institute of Information and Communication Technologies (IICT)-BAS, as well as on the ground of the decision of the scientific Jury (Protocol №1 from 16.01.2024). This review fully corresponds to the Act for the development of the academic staff in the Republic of Bulgaria (ZRASRB), the Regulations of the Council of Ministers (CM) for its applications, the Regulations of BAS for its applications, and the Regulations for the specific conditions for awarding scientific degrees and occupying academic positions in IICT-BAS.

1. General description of the presented materials and biographical data.

The candidate Assoc. Prof. Dr. Vera Angelova-Dimitrova graduated in 1989 from Technical University-Sofia (TU-Sofia) as a M.Sc. Engineer in Electronics and Automation. From 1989 to 1991 she underwent postgraduate studies at the Institute of Applied Mathematics and Informatics of TU-Sofia and acquired the qualification of engineer-specialist in applied mathematics and informatics. In the period 1991-1993 she was a PhD student in the scientific specialty „Automatic control theory“ at the Institute of Informatics-BAS. She defended the educational and scientific degree „Doctor“ (PhD) in 1995. From 1995 to 2005 she was a research assistant at the Institute of Information Technologies-BAS, where in 2005 she held the academic position of „Senior Research Fellow II degree“ („Associate Professor“) in the scientific specialty „Application of the principles and methods of cybernetics in various fields of science (technical)“. Since 2010 she has been working as an Associate Professor at the Institute of Information and Communication Technologies-BAS (IICT-BAS) and in 2022 she was elected scientific secretary of the institute.

I received the following documents of the candidate for participation in the competition: CV with three annexes (lists of: all publications, all citations, all activities), copy of the PhD diploma, certificate of work experience in the specialty, certificates of participation in projects, list of the scientific publications for participation in the competition, list of textbooks and

teaching manuals, list of citations for participation in the competition, abstracts of the publications in Bulgarian and in English for participation in the competition, copies of 28 publications, 3 textbooks and 2 teaching manuals for participation in the competition, reference on the fulfillment of the minimal national requirements to become professor, reference on the fulfillment of the minimal requirements of IICT-BAS, reference on the original scientific and scientific-applied contributions (including a scheme of the scientific results), declaration for the absence of plagiarism.

The candidate Assoc. Prof. Vera Angelova-Dimitrova fulfills all the requirements stated in the ZRASRB, the Regulations of the CM for its application, the Regulations of BAS for its application, and the Regulations for the specific conditions for awarding scientific degrees and occupying academic positions in IICT-BAS. The presented scientific publications entirely correspond to the topic of the competition.

2. General characteristics of the candidate's scientific research and application activities.

Assoc. Prof. Vera Angelova-Dimitrova presents **28** scientific publications for participation in the competition (24 of them are in issues, which are refereed and indexed in the world secondary literature sources (Scopus, Web of Science) and 4 publications are in unrefereed peer-reviewed journals or edited collective volumes). From the total number of publications, **17** are in journals with Impact Factor (IF) (including 2 in category Q1, 2 – in Q3, 8 – in Q4), **7** are in issues with Science Journal Rang (SJR). Five of the publications are single-author, 9 have one co-author, 4 have two co-authors, and 10 are with more than two co-authors. In 4 of the joint publications Assoc. Prof. Vera Angelova-Dimitrova is the first author. For the criteria of **group B**, 10 publications are included, which makes **240** points (100 points being the necessary minimum). The publications presented in **group Г** are 18 resulting in **338,3** points (200 points being the necessary minimum). This clearly shows that the publication activity of the candidate significantly exceeds the minimal requirements (the national ones and the ones of IICT-BAS).

For the criteria of **group Д**, a list of 101 citations of the candidates's publications for the participation in the competition is presented, which makes **866** points (100 points being the necessary minimum).

For the criteria of **group E**, the supervision of one successfully defended PhD student is reported and an information about the international and the national scientific and educational projects the candidate participated in is given. In **group E**, Assoc. Prof. Vera Angelova-Dimitrova included also 3 textbooks and 2 teaching manuals (all in French) for the course she taught at Technical University Sofia and for the course she is teaching up to the present time at Sofia University „St. Kliment Ohridski“. In 4 of the 5 textbooks and manuals, she is single author. Assoc. Prof. Dr. Vera Angelova-Dimitrova has an active research activity through participation in 4 national scientific or educational projects and 1 international scientific project funded by the 7th Framework Programme of the European Commission. Thus, the candidate's activities included in **group E** make **250** points (150 points being the necessary minimum).

Table 1 presents in a compact form the information on the fulfilment of the minimum requirements for each group of criteria.

Table 1. Requirements for the academic position „professor” and criteria values of Assoc. Prof. Dr. Vera Angelova-Dimitrova.

Group of criteria	National requirements	Requirements of IICT-BAS	Values of the candidate Assoc. Prof. Dr. Vera Angelova-Dimitrova
A	50	50	50
B	100	100	240
Г	200	220	338,3
Д	100	120	866
E	150	150	250

From the analysis of the above information it follows that the candidate’s activities significantly exceed the respective necessary minima.

It should also be noted that Assoc. Prof. Vera Angelova-Dimitrova has also a significant expert activity – she is a member of the editorial boards of the international Journal of Information Technology and Control and of the national scientific series Lectures Notes in Computer Science and Technologies of IICT – BAS and she is the secretary of the international journal Cybernetics and Information Technologies.

3. Evaluation of the candidate's pedagogical training and activity.

It has to be also mentioned that Assoc. Prof. Vera Angelova-Dimitrova has an active and long-standing teaching career, including lecturing and tutoring in French in the discipline „Linear control systems“ at Technical University-Sofia (in the period from 1996 till 2009), as well as karkto lecturing and tutoring in French in the disciplines „Fundamentals of statistics“ and „Applied statistics” at Sofia University „St. Kliment Ohridski“ (from 2012 until present). In these disciplines she is the author of 3 textbooks and 1 teaching manual and co-author of 1 teaching manual (all in French). In the three textbooks the theory is presented in a very precise and comprehensible way, while the two teaching manuals include relevant examples and exercises to further facilitate the assimilation of the theoretical material. Under the supervision of Assoc. Prof. Dr. Vera Angelova-Dimitrova, the dissertation on "Individuality and decision-making patterns on the Internet" was successfully defended by the full-time PhD student Rumen Ketipov.

4. Analysis of the scientific and scientific-applied research results of the candidate.

The candidate’s publications for participation in the competition contain significant scientific and scientific-applied achievements. Presented in a compact form, they are:

Scientific contributions:

1. The perturbation analysis approach based on Fréchet derivatives techniques is developed for problems with singular operator matrix.

A development of the standard perturbation analysis technique is proposed by extending it to the case of a singular operator matrix. A projection of the disturbance into subspaces of positive co-dimension is proposed. The operator matrix of the projected problem is nonsingular, which overcomes the shortcoming of the standard technique and allows obtaining the equation of solution error by multiplying the projected operator equation with the inverse of the nonsingular projected operator matrix.

2. Lyapunov's majorant techniques and fixed point principles are applied to estimate the error in projection of the problem in reduced dimensional space.

Lyapunov's majorant technique as a preliminary stage in the application of the fixed point topological principles has been applied to obtain non-local nonlinear bounds of the error representing the distance between the approximate solution of the non-symmetric matrix differential Riccati equation of low rank (projected in a reduced dimension space) and the exact solution of the non-scaled non-symmetric matrix differential Riccati equation of full rank.

3. Relations with independent significance are derived:

- The analytical solution of the symmetric matrix differential Riccati equation is derived and proved.
- The analytical expression of Fréchet first derivative of the function $A \rightarrow A^p$ is formulated at the point A at $p = -1/s$, where s is a natural number.

Scientific-applied contributions:

1. New absolute and relative condition numbers, asymptotic and non-local upper bounds on round-off errors, and upper residual bounds are derived in solutions of matrix equations from automatic control theory and other areas.

They are computed in a finite precision machine arithmetic environment using a numerically stable algorithm. The derived perturbation bounds are new as no such bounds are known in the literature for the considered problems. The effectiveness of the proposed condition numbers and perturbation estimates is confirmed experimentally.

2. Known asymptotic and nonlocal perturbation bounds on solutions of matrix equations are improved.

The bounds are alternative to the perturbation bounds existing in the literature. The superiority of the proposed norm-wise perturbation bounds is confirmed by numerical examples.

3. The properties of asymptotic and non-local perturbation bounds existing in the literature for two types of matrix equations and for the symmetric differential Riccati matrix equation in a given time interval are studied.

The obtained results show that when the problem conditioning deteriorates, some bounds known in the literature do not reach the estimated quantity, which is unacceptable for a perturbation bound. The application areas of the studied perturbation bounds are formulated.

4. Norm bounds on the second and higher order terms of the disturbance in matrix A of the exponential function $A \rightarrow A^p$ for $p = -1/2$ and $p = \pm r, r \geq 2$ are derived.

A very good impression is made by the attached scheme of scientific results contained in the scientific publications for the competition.

5. Impact of the results achieved by the candidate on the scientific works of other authors.

The scientific and the scientific-applied contributions in the publications of the candidate are original and have a substantial significance for the science and the practice. In this respect, the listed 101 citations of the publications for participation in the competition show that the achieved significant results are well known and used by the scientific community in Bulgaria and abroad.

6. Critical remarks and recommendations.

I do not have any serious critical remarks.

7. Conclusion.

Based on the analysis of the presented materials and by considering the significant scientific and scientific-applied research results, the teaching experience and the scientific-organizational activities of the candidate, all conducted at a very high level, I am convinced that they fully correspond to the requirements of the Act for the development of the academic staff in the Republic of Bulgaria (ZRASRB). All requirements of the Regulations of the CM for ZRASRB application, the Regulations of BAS for ZRASRB application, and the Regulations for the specific conditions for awarding scientific degrees and occupying academic positions in IICT-BAS for the award of the academic position „Professor” are met. In relation with this, it has to be noted that the candidate’s activities in all groups of criteria significantly exceed the respective necessary minima. **On the basis of all this, I give a high positive evaluation of the candidate and I am convinced in recommending to the honorable Scientific Jury to award the academic position „Professor” to Associate Professor PhD Vera Angelova Angelova-Dimitrova in the professional field 5.2. Electrical engineering, electronics and automatics, the scientific specialty „Application of principles and methods of cybernetics in various fields of science (technical)”.**

Sofia
26.02.2024

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