

REVIEW

by **Ivan P. Popchev**, academician at **BAS**

of dissertation work for conferring of the educational and science degree **PhD** by
programme: 'Application of the Principles and Methods of Cybernetics in Different
Spheres of Science'

by **Bistra Yulianova Zaharieva**

titled 'Intelligent Methods of Analysis of Rehabilitation Processes'

I have been appointed as a member of the Academic Jury with Order № 257 from 28.12.2018 of the Director of the Institute for Information and Communication Technologies (IICT) Prof. Galya Angelova, issued on the ground of art.4 (2) of the Act of the Development of the Academic Personnel in the Republic of Bulgaria (ADAPRB) and Decision of the Academic Council of IICT-BAS (rec. of proceedings № 9 from 19.12.2018) in reference to the procedure of acquiring of educational and science degree PhD, professional subject 5.2 'Electrical engineering, Electronics and Automation', doctoral programme 'Application of the Principles and Methods of Cybernetics in Different Spheres of Science' by Bistra Yulianova Zaharieva with a dissertation work on the topic 'Intelligent Methods of Analysis of Rehabilitation Processes'.

I have been appointed as a reviewer at a meeting of the Academic Jury on 04.01.2019. As a member of the Academic Jury I have received the following materials:

1. Order № 257 from 28.12.2018 from Prof. Galya Angelova.
2. Dissertation work.
3. PhD abstract.
4. Publications on the topic of the dissertation work.

The assessment of the dissertation work is based mainly on the requirements of the ADAPRB, the Rules for its Implementation (RIADAPRB) and the Rules for the Specific Conditions for acquiring of science degrees and holding of academic positions in IICT-BAS (Rules of IICT), therefore they will be duly quoted:

1. According to art.6 (3) of the ADAPRB 'the dissertation work shall contain scientific or applied research results, which offer original contribution to science. The dissertation work shall show the candidate's profound theoretical knowledge on the respective subject, as well as their ability of independent scientific research.'

2. According to art.27 (2) of the RIADAPRB the dissertation work should be presented in type and volume corresponding to the specific requirements of the primary unit. The dissertation work should contain: a title page; contents; introduction; presentation; conclusion- summary of the obtained results, accompanied by an originality declaration; bibliography.

According to the Rules of IICT, chapter 2, art.3:

1. For acquiring of the educational and science degree PhD:

- 1.1. The candidate's dissertation work should be based on at least three scientific publications, one of which being in a magazine having an impact factor or in a specialized international issue.

The dissertation work contains 148 pages, 8 figures, 15 tables. Its supervisor is **prof. Lyubka A. Doukovska, PhD, DSc.**

The aim of the dissertation work is defined on page 6: 'Using the means of the modern paradigms from the sphere of the intelligent systems to develop highly effective intelligent methods for analysis of rehabilitation processes. The following tasks have been formulated in order to achieve this aim:

1. To systematize the existing intelligent methods for analysis of rehabilitation processes;
2. To recommend methodology for analysis of rehabilitation processes with patients having socially important diseases;
3. To develop generalized net models of rehabilitation processes with patients having musculoskeletal complaints, as well as with patients having proximal humeral fractures;
4. To apply intelligent methods for analysis of rehabilitation processes with patients having ankylosing spondylitis - Behterev's disease, to achieve higher efficiency of the rehabilitation processes;
5. To apply intelligent methods for analysis of rehabilitation processes with patients having chronic degenerative illness of the knee joint-gonartrosis to achieve higher efficiency of the rehabilitation processes;
6. To systematize the legal aspects while using data related to the physical condition of patients in hospitals.

The dissertation work deals with the following items in a consistent order:

- ❖ Introduction (4-7)
- ❖ Review of the intelligent methods for analysis of complex processes (**Chapter 1**, 8-37);
- ❖ Analysis of rehabilitation processes in case of ankylosing spondylitis and chronic degenerative illness of the knee joint (**Chapter 2**, 38-66)
- ❖ Experimental results from applying the intelligent methods of rehabilitation processes (**Chapter 3**, 67-110);
- ❖ Ethical norms in applying intelligent methods for analysis of rehabilitation processes (**Chapter 4**, 111-127);
- ❖ Conclusion (128-130);
- ❖ Summary of the obtained results (131)
- ❖ Guidelines for future research (132);
- ❖ Publications on the topic of the dissertation work (132);
- ❖ Declaration for originality of the results- unsigned and undated;
- ❖ Bibliography (134-148).

Bibliography includes 155 cited works, 133 of them in English and 22 in Bulgarian. These sources show good knowledge of the current problems of the discussed issues. This is on the one hand. On the other hand, **the stated aim and six tasks are new, concerning research and application in the scientific field and are prerequisite for original contribution.**

The bibliography does not include the publications related to the dissertation work.

The contributions in the dissertation work can be briefly systematized as follows:

1. It presents experimental results from the application of the Inter Criteria Analysis of the rehabilitation process data.
2. It offers a generalized net model of physical evaluation with a patient having musculoskeletal complaints. It is claimed that this model can provide a frame which can be used by the physical therapeutics.

3. It offers a generalized net model of diagnostic evaluation of proximal humerus fractures. It is claimed that this model can be used by the practitioners for diagnosis of patients who are supposed to have proximal humerus fracture.
4. It formulates proposals for amendments of the Professional Ethical Code of the doctors in Bulgaria. Some reasons are mentioned for a future Ethical Code of applying intelligent methods of analysis of rehabilitation processes.

6 publications in English are on the dissertation work, as follows:

- ❖ 3 publications are in journals (NNo.1,2 and 3);
- ❖ 1 publication is in journals with SJR 0.25 (No4);
- ❖ All publications are in **co-authorship**;
- ❖ 2 publications (NNo. 5 and 6) are to be printed.

3 citations are noticed, two of publication No.4 and one of publication No.1. The candidate has participated and delivered papers in four scientific events, three of them being abroad.

All specific requirements of IICT-BAS for acquiring of the educational and science degree PhD are fulfilled, as well as the minimum national requirements according to Decree of the Council of Ministers No 122 from 29.07.2018 (SG 56) appendix to art.18 (1), field 5. Technical sciences-table 1, where the minimum required points for PhD for index 1 are 50 and for indexes from 5 to 11-30 points altogether, however index 7 alone for publications based on PhD thesis requires 40 points.

Critical notes:

1. Bibliographical description of some cited works is incomplete: missing pages, publishing company, ISSN or ISBN.
2. The publications of candidate on PhD thesis are not included in bibliography, although two cited in the thesis publications (NNo.151 and 152) are missing in the list of the publications on the dissertation work.
3. Some spelling, grammar and stylistic mistakes are not corrected. For example, fig. 3.1 can be seen twice (page 73 and page 74), the phrases 'data basis' and 'Computational intelligence' cannot be defined in [8]. What is written on page 20 for [125], on page 32 for [148], and on page 75 for [150] is not true.
5. The publications based on the dissertation work are marked in the text with (*), which breaks the continuity of citations.
6. There are bibliographic items, for example [89], [142], [151], [153], [154], [155], etc. which are not cited in the text.

Questions on the PhD thesis:

1. Which are the methods of the artificial intelligence and why are they methods? 'Classical methods' (p.12) and 'classical artificial intelligence' (p.13) can be found in the text?
2. Where are the definitions for 'computer intelligence' (p.14) and 'applied computer intelligence' (p.16) borrowed from?
3. Although there are no generally accepted definitions, in the dissertation work what are the working definitions for 'intelligent methods' and 'intelligent systems'? Is it possible then to talk about 'unintelligent systems' and 'unintelligent methods'?

4. Why is the generalized net model referred to as 'an extremely adequate and correct method' (p.17)? Is it possible to indicate other methods and approaches for it to be compared with?
5. Is the suggested in article [3*] model, shown on fig.3.2 (p.91) the only possible one and has it been compared to other models? How should it be comprehended that the suggested model can provide 'a frame' (p.99)?
6. The same questions from 5 can be asked concerning the model on fig.3.3 (p.102) and 'frame' on p.110.
7. What proof do the statements that the models 'provide a frame' give for using them 'by practitioners for diagnosis of patients'? Are there any examples of 'practitioners'?
8. Why does 'model' on p.110 three lines down become 'method' (p.110)?
9. The summary states that the aim of the dissertation work is 'using the means of the modern paradigms from the sphere of the intelligent systems to develop highly effective intelligent methods for...'. So, these developed methods should be listed, proving why they are called 'intelligent', which is or which are the criteria of their 'high efficiency'? Lastly, which are the 'modern paradigms from the sphere of the intelligent systems'?

The reviewer is convinced that the critical notes and the questions on the dissertation work will lead to strong motivation for new research and applications and will bring more specificity in the directions for future research (p.132).

The PhD abstract contains 30 pages and presents the dissertation work.

CONCLUSION

The PhD thesis complies with the requirements of ADAPRB, of RIADAPRB, of the specific requirements of the Regulation of IICT-BAS and of the minimum national requirements of the Decree of the Council of Ministers № 122 from 29.06.2018.

I give my positive conclusion for the award of educational and scientific degree of PhD to Bistra Yulianova Zaharieva by doctoral programme 'Application of the Principles and Methods of Cybernetics in Different Spheres of Science'.

14.01.2019 г.

Reviewer: