OPINION

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Regarding a procedure of promotion to the **scientific degree "Doctor of Sciences"**
Scientific Area: **4. Natural Sciences, Mathematics and Informatics**
Professional Direction: **4.6. Informatics and Computer Sciences**

Author of the dissertation thesis: **Prof. Stefka Stoyanova Fidanova, PhD**
Title: **"ACO Method for Solving Combinatorial Optimization Problems"**

According to Order No. 92/31.03.2023 of the Director of the Institute of Information and Communication Technologies (IICT) at the Bulgarian Academy of Sciences, I was appointed member of the Scientific Jury for defense of the dissertation thesis by **Prof. Stefka Stoyanova Fidanova, PhD** for the acquisition of the scientific degree **"Doctor of Sciences"** in Professional Direction **4.6. Informatics and Computer Sciences.**

As a member of the Scientific Jury, I have been provided with:

1. A dissertation thesis for acquisition of the scientific degree "Doctor of Sciences".
2. Synopses of the dissertation thesis in Bulgarian and English.
3. Copies of the publications, which the thesis is based on.
4. A Reference from Stefka Fidanova regarding the accomplishment of the minimal requirements of IICT for the acquisition of the scientific degree "Doctor of Sciences".

The dissertation thesis by **Stefka Fidanova** is 187 pages long, and comprises an Introduction, six chapters, a Conclusion with formulated scientific and scientific-applied contributions, a list of 19 publications connected with the dissertation thesis, a list of 52 citations, a Declaration of the results originality, and a Bibliography of 128 literature sources. The thesis has been illustrated by 76 tables and и 16 figures. In the presented form, the dissertation thesis corresponds to the specific requirements defined in Art. 27(2) from the Council of Ministers' Regulation for the Application of the Academic Staff Development Act in the Republic of Bulgaria (ASDARB).

The aim of the dissertation thesis, as formulated by the author herself, is "development of algorithms based on the Ant Colony Optimization method towards solving real-life and industrial problems".

In order to accomplish the **aim** of the dissertation thesis, the following particular **tasks** have been laid down:

- Development of an algorithm for solving the knapsack problem;

- Development of an algorithm for GPS surveying problem;
- Development of an algorithm for wireless sensor network positioning according to two criteria – minimal number of sensors and minimal energy used;
- Development of an algorithm for workforce planning problem;
- Development of an algorithm for modelling of passengers' flow according to two criteria – travel time and travel cost.

The timeliness of the dissertation thesis is undisputable due to the fact that the Ant Colony Optimization method (ACO method) has been proved to be one of the most successful metaheuristic methods for solving combinatorial problems. The formulated problems themselves offer possibility of application of the ACO method in various combinatorial problems and decision making processes in distinct areas of practical application.

The presented list of publications related to the dissertation thesis comprises **19 publications** including **1 monograph** in the renowned international academic publisher *Springer*, **2 single-authored papers** and **16 papers written in coauthorship**, in 12 of which Stefka Fidanova was the first author. **One of the papers is published in a journal with Impact Factor** (in a Q1, Top 10% journal), and **11 papers are published in journals with Impact Rank**. All publications made with respect to the dissertation thesis have been published after 2016, and have not been used in preceding promotion procedures according to the ASDARB. The presented list of 52 citations covers only those publications made with respect to the thesis, which is a good testimonial for the timeliness of the topic of the presented dissertation thesis, and the results achieved therein.

The presented synopsis of the dissertation thesis amounts to 49 pages in Bulgarian and 46 pages in English. It does reflect the essence and contents of the thesis, including the aim and tasks, както и тяхното изпълнение и постигнатите резултати.

Regarding the dissertation thesis, I would like to emphasize on the substantially more thorough application of the ACO method, including hybrid algorithms and the InterCriteria Analysis method, to the knapsack problem, the problem of GPS network inspection, the problem of constructing a wireless sensor network, and workforce employment, in comparison to the rather sparse application of the ACP method to the passengers' flow problem presented in Chapter 7.

Despite the undeniable qualities of the presented dissertation thesis, I cannot help but draw attention to the following few facts:

1. An imprecise translation of the term "index matrix" was used, as well as imprecise translations of the terms "degree of consonance", "degree of dissonance" …
2. The titles of the subitems of "2.2 Variants of the ACO Algorithm" were left untranslated from English.
3. On page 84, Table 6.14 was incorrectly cited.
4. In the dissertation thesis, 128 literature sources are given while the synopses declare they are 127.

5. There is a substantially high number of grammar mistakes, both in Bulgarian and English, e.g. "sociaty", "differen", "planing", and many others.

The issues listed above leave the reader with the impression of a work half-done and lack of strife for perfection in any aspect whatsoever.

In her dissertation thesis for acquisition of the "Doctor of Sciences", Stefka Fidanova presented 5 purely scientific and 4 applied science contributions. I would first like to acknowledge the positive change in the formulation of the contributions back from the times of the pre-defense, and the way they are now presented in the dissertation thesis. **I endorse all of the claimed contributions by Stefka Fidanova**, but in my opinion **only the first formulated scientific contribution may be considered purely scientific**, while all the **rest four are essentially applied science**. Respectively, **the proposed four applied science contributions I accept as purely applied,** as they concern the software implementations of the algorithms developed.

I know personally Stefka Fidanova from her presentations at scientific forums as well as from working on joint projects. She has certainly built an authority of a qualified scientist, and at a personal level she has the reputation of a conscious and responsible colleague. The above formulated critical remarks towards the dissertation thesis in no way diminish the results achieved, but serve to trigger a pursuit for perfection that a scientist, otherwise holding to that high of a standard, should be demonstrating in each and any of their acts of expression.

In forming the overall assessment of the dissertation thesis, one should render account of the requirements formulated in the ASDARB and the IICT's Regulation of the its application. In accordance with the presented Reference for the accomplishment of the minimal requirements of IICT, **Stefka Fidanova meets**, and certainly **exceeds** the requirements for acquisition of the **scientific degree "Doctor of Sciences"**, as stipulated in the IICT's Regulations for Application of ASDARB.

This all said, I certify that **the requirements for academic promotion to the scientific degree "Doctor of Science", as formulated in the ASDARB, and in the Regulations of IICT for Application of the Act, have been fulfilled**. The presented dissertation thesis and the publications on the thesis giving visibility of the results obtained, provide me with the justification for giving my **positive evaluation** and for recommending to the respected members of the Scientific Jury to vote for the promotion of **Stefka Stoyanova Fidanova** to the **scientific degree "Doctor of Sciences"** in Professional Direction **4.6. "Informatics and Computer Sciences".**

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Sofia