

Short review

of the thesis of Prof. Dr. Stefka Stoyanova Fidanova
“Ant colony optimization for solving combinatorial optimization problems”,
presented for awarding the scientific degree “doctor of science”
in Professional area 4.6 Informatics and computer science
by Prof. Dr. Maria Nisheva-Pavlova – Faculty of Mathematics and Informatics,
Sofia University St. Kliment Ohridski

Pursuant to Order 92/31.03.2023 of the Director of the Institute of Information and Communication Technologies I am nominated as a member of the scientific jury for the defense of the submitted thesis in professional area 4.6 Informatics and computer science, entitled “Ant colony optimization for solving combinatorial optimization problems”.

1. General characteristics of the dissertation and the presented materials

The dissertation contains 187 pages of text and includes eight chapters, a list of references, a list of tables and a list of figures.

In addition to the dissertation on the procedure, the following are also presented:

- abstracts in Bulgarian and English;
- a European-style CV;
- copy of diploma for educational and scientific degree “doctor”;
- list and copies of the candidate’s publications by dissertation results;
- reference for noticed citations of the candidate’s publications;
- certificate of fulfillment of the minimum requirements of the ICT for obtaining the scientific degree “doctor of science” in the professional field Informatics and computer science;
- declaration of originality of the results of the dissertation.

2. Applicant data

Prof. Stefka Fidanova has Master’s degree in Mathematics, acquired at the Faculty of Mathematics and Informatics of Sofia University St. Kliment Ohridski. In 1999, she defended a PhD thesis in the field of parallel algorithms and architectures. She was awarded scholarships and worked as a postdoctoral fellow in prestigious European universities. Since 1993, she has worked

at BAS consequently as an assistant professor, senior assistant professor, associate professor. Since 2016, she has held the academic position of professor at the IICT – BAS.

I know Prof. Fidanova from a number of her participations in international scientific conferences, where we had the opportunity to make useful professional contacts. I have excellent impressions of her thoroughness, precision and broad research horizons.

3. Relevance of the research area and significance of the research problem

The dissertation is dedicated to research in the field of combinatorial optimization. It presents the author's results in the development and analysis of numerous algorithms based on the so-called ant method for solving significant tasks of public practice and industry.

The field of research of the author is complex and topical, and its topicality is determined by the wide variety of optimization tasks of non-polynomial complexity that are significant for practice, for the solution of which it is appropriate to search for solutions close to the optimal ones, using metaheuristic methods.

The goal of the dissertation and the tasks for achieving this goal, which the author formulates, are determined on the basis of an appropriately presented analysis of achievements and open questions in the chosen field. The goal is significant and the tasks fully correspond to the goal.

4. Analysis of the content, results and contributions of the doctoral thesis

The dissertation consists of 187 pages of text and includes eight chapters, a list of references, a list of tables and a list of figures.

The introductory first chapter presents the field, the purpose and tasks and the chosen methodology of the research.

The second chapter discusses the basic principles and variants of the ant method.

In the third chapter, the knapsack problem is presented and an approach to solving it using the ant method is proposed.

The fourth chapter is devoted to the development of variants of solutions to the GPS network inspection task based on the ant method.

The fifth chapter presents the approaches proposed by the author to solve the task of building a wireless sensor network.

The sixth chapter is devoted to the author's results in solving the workforce planning task.

The seventh chapter discusses the proposed algorithm based on the ant method to solve the passenger flow modeling problem.

The conclusive eighth chapter presents the author's publications by results of the dissertation and noted citations of these publications in other authors' works.

The main contributions of the doctoral thesis of Prof. Stefka Fidanova may be summarized as follows:

- A hybrid algorithm is developed for solving the knapsack problem, which combines in an original way an appropriate application of the ant method and a proposed local search procedure.
- A GPS network inspection algorithm based on the ant method is proposed and analyzed.
- Algorithms based on the ant method designed to solve the task of building a wireless sensor network have been developed and analyzed.
- An algorithm for solving the workforce planning problem based on the ant method was created and studied.
- An algorithm based on the ant method was developed, designed for passenger flow modeling in the presence of different transport options.
- A software implementation of the developed algorithms was made.

The dissertation makes an excellent impression with the scope and depth of the presentation. The achieved results are original and significant and fully correspond to the defined goal.

5. Publications on the doctoral thesis. Reflection on the works of other authors

The author of the dissertation has more than 200 scientific publications, which are cited in more than 1250 publications of other authors.

The results obtained in the dissertation are presented in a total of 19 publications:

- one monograph published by the prestigious publishing house Springer and indexed in Scopus;
- one paper – in a scientific journal with an IF falling into Q1 of the JCR for the scientific field of the dissertation;
- 11 papers – in scientific editions with SJR;
- five papers – in scientific editions, referenced and indexed in Scopus;
- one paper – in an international scientific journal.

All the publications were issued after the last procedure under the Act on Development of the Academic Staff in the Republic of Bulgaria, in which the author of the dissertation participated. The monograph is single-authored, and all papers are co-authored. I suppose that all co-authors contribute equally to each of the collective publications.

Data is presented for 52 citations of publications on the results of the dissertation in works of other authors, published in editions, referenced and indexed in WoS and/or Scopus.

In this way, the author of the dissertation accumulates a total of 360 points by group of indicators “Г” and 312 points by group of indicators “Д” and therefore fulfills and significantly exceeds the requirements of Art. 3 of the Regulations on the specific conditions for the acquisition of scientific degrees and for the occupation of academic positions at IICT - BAS for the acquisition of the scientific degree “doctor of science” in professional area 4.6 Informatics and computer science.

6. Abstract

The abstract meets all the requirements for its preparation and fully and accurately presents the topic, purpose, content, achieved results and contributions of the dissertation.

7. Critical Remarks and Recommendations

In general, the dissertation is designed carefully and correctly. The presentation is competent and sufficiently thorough. I have no significant critical comments to its content.

8. Summary

Summing up, I consider that the dissertation of Prof. Stefka Fidanova fully satisfies and significantly exceeds the requirements of the national regulations and the specific conditions and requirements of the Institute of Information and Communication Technologies. Its author has achieved significant research results that make an original contribution to the chosen field of study. My assessment of the dissertation, the abstract and the scientific contributions of their author, Prof. Stefka Fidanova, is **positive**.

Therefore, I advise the honorable scientific jury to award to Prof. Stefka Stoyanova Fidanova the scientific degree “doctor of science” in professional area 4.6 Informatics and Computer Science.

Sofia, May 25, 2023

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