REVIEW

on the Thesis for awarding educational and scientific degree PhD
under the Scientific Field 4.
Natural sciences, mathematics and informatics
Professional Area 4.6. Informatics and computer sciences
Scientific speciality: Informatics

Author of the PhD Thesis:

Stefan Kostadinov Stefanov

Theme of the PhD Thesis:

„Innovative methods to support decision-making in wildland fires or floods“

Reviewer:

Prof. Olympia Nikolaeva Roeva, PhD
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1. **Relevance of the problem developed in the PhD thesis in scientific and scientific-applied terms. Degree and levels of relevance of the problem and the specific tasks developed in the PhD thesis.**

A particularly topical issue in recent years has been the fight against forest fires and floods. According to the European Forest Fire Information System EFFIS, twice as many forests were burned in Greece by August 5th than the 2008-2020 average. Last year's floods have killed hundreds of people and damaged billions of euros.

There is a need to develop new, modern, flexible and efficient computer-based information systems to help manage and optimize a number of economic and social activities.

In the context of the above, the problem in the PhD thesis – **Innovative methods to support decision-making in wildland fires or floods** – is relevant both in scientific and scientific-applied terms.

In the introduction of the thesis the PhD student considers the role of innovative methods to support decision-making in natural disasters for the sustainable development of the country.

The PhD student aims to "study methods for developing web Geographic Information Systems (GIS) applications and to present a methodology for developing information systems (IS), supporting decision-making in cases of wildland fires or floods", as well as to "develop and test information systems to support decision-making in cases of wildland fires or floods".

In order to achieve the set goal, Stefan Stefanov defines the following tasks:

1. Theoretical analysis of basic concepts related to the development of IS, supporting decision-making in wildland fires or floods – wildland fires, floods and GIS.
2. Presentation of a methodology for creating IS supporting decision-making in wildland fires or floods;
3. Development of IS to support decision-making in wildland fires or floods.
4. Collection, analysis, evaluation and processing of available geospatial data for wildland fires and floods;
5. Selection of appropriate software solutions for the development of web GIS applications, in connection with the available open source web GIS software products, in terms of cross-platform integration with stable interoperability of geospatial data;
6. Approbation of the developed IS, supporting decision-making in wildland fires that have occurred in the area of State forestry "Zlatograd".
7. Approbation of the developed IS, supporting decision-making for flood risk in Syunik region, Kapan city in Armenia.

2. **Degree of knowledge of the state of the problem and creative interpretation of the literary material**

The dissertation is 121 pages long and includes a total of 55 figures, 5 tables and 6 appendices. It is structured as follows: list of abbreviations and notations used, introduction, 4 chapters, main conclusions, approbation of the results and publications, declaration of originality, thanks, appendices and bibliography. A total of 103 references are cited.

In the review related to forest fires and floods in Bulgaria, based on the report submitted to the JRC of the European Commission on Fire and NSI on floods, the PhD student concludes that GIS for mapping, modeling and visualization of these natural disasters are a particularly suitable tool for planning, design and making management decisions.

Stefan Stefanov has found a reasonable balance between publications with basic research on the topic of the PhD thesis and those that reflect current trends and results in the field.

The high degree of knowledge and interpretation of the state of the problem allow the PhD student to reasonably define the goal and tasks of the PhD thesis.

3. **Brief analytical description of the nature and assessment of the reliability of the material on which the contributions of the PhD thesis are built**

The PhD thesis is well structured and logically consistent, according to the defined tasks to be solved.

Chapter 1 is an review and presents a theoretical analysis of the concepts of forest fires, floods, Geographic Information System, European Forest Fire Information System, Advanced Fire Information System and European Flood Information System. Official statistics on fires in the period from 2009 to 2018 and floods in the period from 2010 to 2019 in Bulgaria are presented.

Chapter 2 of the PhD thesis presents a methodology for the development of information system supporting decision-making in forest fires or floods. Two models are considered – "Model simulating the development of forest fires" and "Empirical model with the construction of a digital terrain elevation model for the surrounding geometry of the area". An "Open source architecture for developing a web GIS application" is proposed.

In Chapter 3, the PhD student proposes the architecture and software implementation of a Web GIS application, which is part of the information system supporting decision-making in forest fires or floods. A methodology for building a web GIS application is presented, which includes conversion of geospatial data into geoJSON file format. The programming languages JavaScript, HTML and CSS are used to ensure the complete functionality of the information system as well as visualization of data for forest fires or floods.

Chapter 4 describes the developed information systems to support decision-making in forest fires in the area of State forestry "Zlatograd" and in case of flood risk in the region of Syunik, Armenia. For each information system, a detailed description of the general information for the specific test area, description and implementation of the respective information systems is given. Both information systems have been tested and their capabilities and functionalities are presented in detail.

4. Scientific and scientific-applied contributions of the PhD thesis

The PhD student formulates 4 scientific and scientific-applied contributions to the PhD thesis, as follows:

1. An analysis of existing GIS was made, as well as a comparative analysis of open source software – QGIS and commercial software – Esri ArcGIS;
2. An algorithm for development of Information systems supporting decision making in wildland fires or floods with open source is presented;
3. A methodology for working with real data has been proposed to visualize parameters for relief, meteorology, plant species and water resources;
4. The architecture of a web GIS application is applied, which is realized with open source software products and tools.

I accept the contributions defined by the PhD student and believe that original results have been obtained, which correspond to the goal set in the PhD thesis.

The directions formulated by the PhD student for future research on the topic make a good impression.

5. **Assessment of the degree of personal participation of PhD Student in the contributions**

The main results of the PhD thesis Stefan Stefanov published in several publications. In one of them he is the single author, and in the others he is the second author. I accept that the PhD student has a great personal participation in the results of the PhD thesis.

6. **Evaluation of the publications on the PhD thesis**

The results of the PhD thesis have been widely disseminated in the scientific field, both in specialized international forums and in scientific series and conference proceedings.

The PhD student presents a total of 4 publications: 2 publications in proceedings of international conferences and 2 publications in scientific book series with SJR, which fulfils the necessary requirements.

There is no list of citations in the materials related to the procedure.

7. **Assessment of the conformity of the autoreferate with the requirements for its preparation, as well as of the adequacy of reflecting the main positions and contributions of the PhD thesis**

The autoreferate is prepared in accordance with the requirements. It has a volume of 25 pages and briefly reflects the content of the PhD thesis and the main conclusions of each of the chapters.

8. **Opinions, recommendations and notes**

I would like the PhD student to demonstrate the developed Web applications for decision making in case of fires and floods.

9. **Conclusion with a clear positive or negative assessment of the PhD thesis**

My opinion is that the PhD student Stefan Stefanov demonstrates good knowledge in the specific field and scientific potential to achieve original ideas. The PhD thesis is in the form and volume corresponding to the specific requirements. In the PhD thesis the scientific and applied results are achieved, which represent an original contribution to science. The results are published in reputable specialized scientific journals and series, and / or presented in international scientific forums.

Based on the above, I confirm that the PhD thesis of Stefan Kostadinov Stefanov meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, as well as the Internal Regulations for its application in the Institute of Information and Communication Technologies of the Bulgarian Academy of Sciences, for awarding the educational and scientific degree "Doctor of Philosophy". The results achieved give me reason to express my positive assessment of the thesis and to recommend to the respected Scientific Jury to award Stefan Kostadinov Stefanov the educational and scientific degree "Doctor of Philosophy" in Scientific Field 4. Natural sciences, mathematics and informatics, Professional Area 4.6. Informatics and computer sciences, Scientific speciality: Informatics.

30.08.2021 г.

Sofia

(Prof. Olympia Roeva, PhD)