**OPINION**

for PhD thesis work for award
of educational and scientific degree "Doctor"
on Professional Degree: 4.4. Earth Sciences,

Specialty "*Cartography and Geographic Information Systems*"

on

**PhD Student Stefan Stefanov Genchev,** ***NIGGG-BAS***

on the topic: "NATURAL ZONE 2000 MAPPING

USING REMOTE RESEARCH AND GIS "

**by a member of the Scientific Jury**

**Associate Professor, Dr. Georgi Nikolaev Jelev,**

*Space Research and Technology Institute - BAS*

The opinion was prepared in pursuance of Order No 01-36 / 27.02.2020 of the Director of NIGGG-BAS and decision under the procedure of (*Minutes No. 1 / 04.03.2020*).

Pursuant to § 40 of the *Transitional and Final Provisions to the LAW for amendment and supplement to the Law on the Development of the Academic Staff in the Republic of Bulgaria* (SG, issue 30 of 03.04.2018, effective 05.05.2018) The educational and scientific degree "Doctor" of doctoral student Stefan Genchev is carried out under the transitional conditions and rules of LDASRB.

The materials submitted for review by Stefan Genchev - Dissertation work and Abstract, satisfy the formal requirements and the necessary conditions for admissibility and start of the procedure for public defense of the dissertation work are in place.

1. **General characteristics and evaluation of the PhD thesis**

The dissertation is 159 pages and consists of an **Introduction**, which describes the relevance, object and subject of the research and the goals and tasks set by the dissertation. The following are **four chapters**, the first and the second, which describe the state and theoretical and methodological foundations of the study, and the third and fourth - present the doctoral analyzes. The paper concludes with a **Conclusion** summarizing the work and the main results obtained from the study. The literature used in the dissertation consists of 66 sources, 27 in Bulgarian and 39 in English. Added 29 used internet sources.

*The written work meets the structure and volume of the requirements for the dissertation.*

1. **Assess the relevance and level of knowledge of the problem**

The relevance is emphasized at the very beginning of the dissertation, as the study is part of the monitoring (Article 17 of Directive 92/43 / EEC) of the status of the wild flora and fauna in the Natura 2000 network and beyond.

From the presented and the analysis of the literary sources show, that the author has a thorough knowledge of the problems addressed in the dissertation. The definition of the subject and object of the study is clearly stated. The goals and objectives are precisely refined.

1. **Evaluation of the scientific and applied contributions of the dissertation**

Three main scientific and applied scientific contributions of the dissertation are presented. The contributions are entirely on the topic of the dissertation. In general, they relate to the study and mapping of the land cover in protected natural sites from the Natura 2000 ecological network using GIS and remote sensing data.

1. **Evaluation of dissertation publications**

Two publications on the topic of the dissertation were presented in which the results of the study were presented. One is an independent report and publication in a collection of international conference *Geoinformation technologies for natural and cultural heritage conservation* held in Sofia. The second is an article by his scientific consultant in the journal *Problems of Geography*, of which he is the first author.

1. **Evaluation of the Abstract**

The Abstract is 52 pages in volume. It is a summary of the main points of the dessert. Its structure corresponds to the PhD thesis.

1. **Joint publications**

I have no joint publications with the dissertation doctor and I am not associated with him / her within the meaning of paragraph 1 of the Supplementary Provisions of LDASRB.

1. **Recommendations and notes**

Adding a geological map would add to the integrity of the study area description (<http://www.geokniga.org/mapgroups/2112>). This will better reflect the nature of the studied sites and the karst nature of the terrain.

In the description of remote data and methods, the term "*resolution*" is incorrectly used in Bulgarian. Most likely this is the result of a literal translation from English, despite the many books and articles in Bulgarian.

There is a misunderstanding of the terms "*spectral resolution*" and "*high spectral resolution*" described on page 51. A wider spectral range does not mean a higher spectral resolution. The spectral resolution is determined by the size of the wavelength interval (discrete segment of the electromagnetic spectrum) and the number of intervals (spectral channels) that a sensor can measure (<https://en.wikipedia.org/wiki/Satellite_imagery>). This means that the *Pleiades-1A / B* images used in the dissertation are very high spatial (0.5 m for panchromatic and 2 m for multispectral channels - blue, green, red, and IR) and low spectral (4 spectral channels with wide spectrum) resolution, which is shown on page 80 (<https://www.satimagingcorp.com/satellite-sensors/pleiades-1/>).

For example, high-spectral resolution images are from the *Earth Observing-1 (EO-1)* satellite. An on-board *Hyperion* spectrometer records reflected solar radiation in 220 unique spectral channels with a width of 10 nm each (https://crisp.nus. edu.sg/~research/tutorial/ eo1.htm).

The use of object-oriented techniques in object-oriented classification of low spectral resolution satellite images give a higher level of processing than traditional pixel-based classification methods. Each classification has its own accuracy, which is a omission in this study.

It is very appropriate to use the generated by satellite image from the Normalized Difference Vegetation Index - NDVI for easy and rapid separation of water areas from other types of land cover. The range of NDVI values is -1 to 1. Negative values (values approaching -1) correspond to water. Values close to zero (-0.1 to 0.1) usually correspond to barren areas of rocks, sands or snow. The low positive values are shrubs and grassland (approximately 0.2 to 0.4), while the high values indicate dense vegetation and forests (values approaching 1), ([https://en.wikipedia.org/wiki/Normalized\_difference\_vegetation\_ index](https://en.wikipedia.org/wiki/Normalized_difference_vegetation_%20index)).

The blue-to-green gradient scale used does not give a good idea of the distribution of earth types at different initial and final values. More appropriate and clearer would be to use a scale separated by intervals, for example : <-0.1; -0.1 to 0.2; 0.2 to 0.4 and> 0.4, for each NDVI classification. This will give comparability of water, bare soils, shrubby vegetation and dense vegetation for each image (cards in Figures 4.16 ÷ 4.19)

**Conclusion**

**Notwithstanding the remarks made, Stefan Genchev's PhD dissertation works meet the requirements and is defensible. It is a fully completed scientific study. The results and contributions achieved are both theoretical and applied in addressing environmental issues through the use of remote sensing methods and GIS in *Natura 2000* sites.**

**Based on the above, I hereby declare my positive attitude (IN FAVOR) towards and I will vote for the award of the educational and scientific degree "DOCTOR" by Stefan Stefanov Genchev PhD student on Professional Degree: 4.4. Earth Sciences, Specialty "*Cartography and Geographic Information Systems*".**

**Sofia, 21.4.2020 г. . . . . . . . . . . . . . . . . . . . . . . . .**

**/** ***Assoc. Prof. Dr. G.Jelev* /**