O P I N I O N

from prof. Georgi Tuparov, PhD

Department of Informatics, New Bulgarian University

on dissertation for obtaining the educational and scientific degree "Doctor"

in the field of higher education 4. "Natural Sciences, Mathematics and Informatics",

professional field 4.6 "Informatics and Computer Science", doctoral program "Informatics"

Doctoral candidate: Nevyana Dimitrova Georgieva

Dissertation topic: "Network coding and design analogues"

By order № 3-PK-233/05.05.2022 of the Rector of New Bulgarian University (NBU) I was appointed a member of the scientific jury for the defense of Nevyana Dimitrova Georgieva, doctoral candidate in professional field 4.6 "Informatics and Computer Science Sciences", doctoral program "Informatics" for awarding the educational and scientific degree "Doctor".

My opinion has been prepared on the basis of the ZRASRB, the Regulations for its application (PPZRASRB), and the Development ordinance of academic staff of New Bulgarian University (DOASNBU).

The submitted documents to the procedure, the dissertation and the abstract meet the requirements of ZRASRB, PPZRASRB and DOASNBU.

Relevance of the problem

The presented dissertation can be attributed to several related areas: finite geometries, design theory, network codes. The initial motivation obviously comes from the ultimate geometries. Central to them is the question of the existence of spreads - sets of subspaces of fixed dimension that break all points of geometry. The dissertation examines the question of the existence of spreads in a special class of geometries, the so-called projective geometries of Yelmslev. These are coordinate geometries above chain rings and have a very close structure to the Galois geometries.

The dissertation examines some new models of algorithms for effective planning and distribution of tasks in a rapidly changing environment, where the speed of decision making is critical, subject to certain rules and restrictions arising from their business nature. It is assumed that with appropriate refinement of the algorithms they will be able to be applied in different areas of economic activity. In this sense, the topic of the dissertation is completely relevant.

General characteristics of the dissertation

The dissertation has a volume of 78 pages and is structured in four chapters and a list of references with 85 titles. The first two chapters do not contain original results.

In the first chapter a brief historical overview and review of the results of the dissertation is made. The second chapter describes some fundamental definitions and results used later in the dissertation. It is divided into three parts, which are respectively dedicated to chain rings, modules above chain rings and coordinate geometries above chain rings (Yelmslev geometries).

The new results are contained in the next two chapters. The third chapter deals with the presentation of modules over end chain rings. It introduces the concept of a standard shape of a matrix over a finite chain ring and proves that for every module above such a ring there is a unique matrix in standard shape whose rows give rise to the module (Theorem 3.3). Using this standard form, the doctoral student presents several algorithms for working with modules. These include an algorithm for converting a matrix to standard form, a module membership test, algorithms for finding the union and intersection of modules, an algorithm for finding a matrix generating the orthogonal module, an algorithm for generating all submodules of a given type for a fixed module.

The fourth chapter is devoted to deriving the necessary and sufficient conditions for the existence of spreads in projective geometries of Yelmslev. The starting point is the classic result of Kirmeyer and Landzhev, according to which in the case of spreads of free submodules the combinatorial necessary condition turns out to be sufficient. In the case of subspaces associated with non-free submodules, this condition is not sufficient, as demonstrated by Theorem 4.13 in Section 4.3. The most important results here are a summary of the condition from Kirmeyer and Landzhev's theorem, which is relevant to spreads from arbitrary subspaces (ie those associated with non-free submodules), as well as several sufficient conditions for the existence of spreads (Theorems 4.10 -4.12).

Scientific Contributions to the dissertation

I accept the claims for scientific contributions presented by the doctoral candidate as admissible and leave them for detailed assessment by the reviewers.

Reliability of the results obtained

Based on the presented materials, I can accept the obtained results as reliable.

Publications that reflect the dissertation

Three publications have been made on the dissertation, one independent and two in co-authorship with the supervisor. I find the publications completely sufficient, especially since the publication presented under number 3 in co-authorship with the supervisor was published in a journal with a high IF and is in Q2 of WoS.

Critical remarks and recommendations

I recommend the doctoral candidate to continue her publishing activity in indexed scientific publications in accordance with the requirements in the professional field 4.6 "Informatics and Computer Science".

Abstract

The abstract has 15 pages and is presented in Bulgarian. It has been prepared in accordance with the requirements of ZRASRB and PPZRASRB. The abstract accurately and completely reflects the content and results of the dissertation.

Conclusion

The dissertation, abstract and publications submitted for review meet the requirements of ZRASRB, PZRASRB and DOASNBU. My assessment of them is positive.

The achieved scientific and applied results give me grounds to recommend to the esteemed scientific jury to award Nevyana Dimitrova Georgieva the educational and scientific degree DOCTOR in the field of higher education 4. Natural sciences, mathematics and informatics, professional field 4.6 Informatics and computer sciences.

08.06.2022   Reviewer:

                                                                          Prof. Georgi Tuparov, PhD