

Review

Procedure for receiving educational and scientific degree “Doctor” (PhD)

by

candidate: Tedis Arben Ramaj,

dissertation: “Algebraic methods for studying some combinatorial configurations and their applications”,

Scientific area: 4. Natural Sciences, Mathematics and Informatics,

professional direction: 4.5 Mathematics,

doctor’s programme: „Algebra, topology and applications“, Algebra department,

Faculty of Mathematics and Informatics (FMI),

Sofia University“ (SU)

This review is prepared by: prof. dr.sci. Peter Gueorguiev Boyvalenkov, Institute of Mathematics and Informatics, BAS, professional direction 4.5 Mathematics, acting as a member of the Scientific Jury according to Order № ПД-38-129 / 01.03.2021 г. of the Rector of Sofia University.

1. General characterization of the dissertation and the presented materials

The presented dissertation is written in English, consists of 84 pages and contains an introduction, 3 chapters and references’ section of 45 titles, as well as author’s reference, list of publications and presentations related to the work, and originality declaration. These parameters correspond to the commonly accepted minimum requirements for meaningful dissertation. A complete set of the remaining necessary documents is also presented.

2. Data and personal impressions for the candidate

Tedis Ramaj has obtained her Bachelor degree from „Aleksander Xhuvani” University in Elbasan, Albania, in 2011 and her Master degree in 2013 from University of Tirana. She has worked in these two universities at part-time positions since 2013 and has full-time assistant position in Tirana University since November 2020. She was enrolled in doctor’s programme „Algebra, topology and applications“ in FMI-SU with scientific advisors assoc. prof. Maya Stoyanova and assoc. prof. Silvia Boumova. In this programme she works on investigations of orthogonal arrays by using algebraic and combinatorial techniques, including ones by using a computer. I am familiar with this area since 2010, as I have several papers in the theme, including the first to show the possibility of using the relations

between orthogonal arrays and their derived in order to reduce the possible distance distributions outcomes. I am familiar also with the work of the candidate in the area. Ramaj has good understanding in the problematics and this is shown from the fact that the exposition of the necessary definitions and results takes a large part of the dissertation's body (maybe slightly larger than usual).

3. Content analysis of the scientific and applied achievements of the candidate from the dissertation and the related publication in the procedure

The contributions by Ramaj are in two directions – computations of distance distributions of orthogonal arrays of fixed length, cardinality (i.e. index), strength and level, and obtaining bounds on the covering radius of orthogonal arrays (again with fixed length, cardinality, strength and level). It is important in both problems to use suitable representation of the systems of linear equations which are used for computing the distance distributions in order to make possible larger volume of computations and analysis of the solutions obtained. The representations, proposed in the dissertation, obtained by multiplication of an initial system by explicit matrix of binomial coefficients allow derivation of bounds for entries of the distance distributions, which in turn facilitate further computations and analysis. The rest of the algorithm is analogous to the previously used but the new restrictions reduce significantly the computations as they rule out more possibilities. This is demonstrated in Chapter 2 for ternary arrays (level 3) of length 15-17, indexes 4-6 and strength 3 and 5. Two nonexistence results are obtained and one of them confirms earlier result of Stoyanova and Marinova and the other is new. In other case significant reduction of the possible distance distributions with respect to internal or external point is obtained. It is shown in Chapter 3 how the information for the computation and investigation algorithm can be used for derivation of upper bounds on the covering radius of orthogonal arrays of fixed length, cardinality, strength, and level. Obtained results are compared to the information from existing examples and the comparison shows that this technique works well. An analogous approach should work for estimation of minimum distance of orthogonal arrays but this is not considered in the dissertation although the notion of minimum distance is introduced.

The results are well described and the required distinction between known results and these obtained by the author is present. The originality of the obtained results is undoubted and they have deservedly served as a base of already published papers. The techniques developed in Chapter 3 can be used for more extensive investigation of the covering radius and minimum distance of orthogonal arrays. The importance of the orthogonal arrays in theory

and practice supports the argumentation for importance and actuality of the investigations carried out in the dissertation.

4. Approbation of the results

The results are presented at several seminars and an international workshop. I was present at a talk by Ramaj in the Spring scientific session of FMI and can confirm that she explains the material convincingly and with understanding. The publications which form the base of the dissertation are three – one in Annual of SU (indexed in MathSciNet), one in Proceedings of BAS (impact factor 0.343 and SJR 0.218 for 2019) and in the proceedings of the international workshop ACCT2020 (published in IEEE Xplore and indexed in Scopus). The results of Ramaj are relatively new and do not have citations so far. All three papers are joint with the scientific advisors and the contribution of all authors is equal.

The published papers satisfy the minimal national requirements (art. 2b, par. 2 and 3 of LDAPRB) and, correspondingly, the additional requirements of SU “St. Kliment Ohridski” for receiving the educational and scientific degree “doctor” (PhD) in the scientific area and professional direction of the procedure. The results obtained in the dissertation and the related papers do not repeat similar from previous procedures for scientific degrees and academic positions. The documents presented show that not plagiarism is detected in the dissertation and the related papers.

5. Quality of the abstract

The abstract (autoreferat) is presented at Bulgarian and English (24 pages each) and fulfills the requirements for preparation of such documents. The results from the dissertation and its content are correctly presented.

6. Critical remarks and recommendations

My critical remarks are related mainly to the missed opportunities to use the technique from Chapter 3 are explained above. I would recommend this to be explored somewhere.

7. Conclusion

Having become acquainted with the dissertation presented in the procedure and the accompanying scientific papers and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I confirm that the dissertation presented and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria as well as the Regulations for the conditions and rules for acquiring Ph.D. degree of the Sofia University “St. Kliment

Ohridski” for acquisition by the candidate of the scientific degree “Doctor” in the Scientific area “Algebra, Topology and applications” and, in the Scientific field: 4. Natural Sciences, Mathematics and Informatics, Professional field: 4.5. Mathematics. In particular, the candidate meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the competition.

Based on the above, I recommend the Scientific jury to award Tedis Arben Ramaj the educational and scientific degree „Doctor” in the Scientific area 4. Natural Sciences, Mathematics and Informatics, Professional field: 4.5. Mathematics (Algebra, Topology and applications).

23.04.2021

Prepared by:

(prof. dr.sci. Peter Boyvalenkov)