

STATEMENT REPORT

on a dissertation for obtaining the scientific degree "Doctor of Sciences"

Area of higher education: 4. Natural Sciences, Mathematics and Informatics

Professional field: 4.5. Mathematics

Author: Danila Cherkashin, Institute of Mathematics and Informatics, BAS

Topic: Extremal Problems in Euclidean Combinatorial Geometry

This report is prepared and presented on the basis of order № 68 from 25.03.2024 of the Director of IMI-BAS for appointment of Scientific Jury and the minutes of the first meeting of the Jury conducted on 27.03.2024.

1. Presentation of the candidate.

Danila Cherkashin obtained his PhD degree in 2018. The title of his thesis being “Extremal problems in hypergraph colorings”. He has been researcher at Saint-Petersburg University (SPbU), 2015–2023, Moscow Institute of Physics and Technology (MIPT), 2016–2021 and St. Petersburg Department of Steklov Mathematical Institute of Russian Academy of Sciences (PDMI RAS), 2021–2023. From 2022 he is with the Institute of Mathematics and Informatics, BAS.

2. Materials presented and preliminary defense

All required for preliminary defense admission and defense admission materials are presented in IMI in time and according to the requirements of the Regulations of IMI. The preliminary defense is conducted on 12.03.2024, followed by a positive evaluation for the defense procedure.

3. Topic and relevance of the dissertation

The dissertation is written in English, has 148 standard pages and consists of introduction, 6 chapters and 128 items bibliography. The dissertation is devoted to extremal problems in the intersection of Euclidean geometry and combinatorics. The emphasis is on several classical combinatorial problems: Steiner tree problem, finding a maximal independent set and finding the chromatic number. All these three problems are NP-complete problems.

4. Publications and citations related to the dissertation

The thesis is based on 10 publications. All papers are joint work with 1, 2 or 3 co-authors. It is assumed that the contribution of Danila Cherkashin in the joint publications is equal to the contribution of the co-authors. One paper is in Q1, 2 papers in Q2, 4 papers in Q3 and 3 papers in arXiv. One paper is cited 20 times, 1 paper - 3 times and 1 paper - 1 time. The results of the

dissertation have been presented in 8 workshop talks in Bulgaria, Russia, Hungary, Italy, France.

5. Description of the results

The first chapter of the dissertation is devoted to the Euclidean Steiner tree problem. It is shown that the set of planar n -point configurations for which the solution of the Steiner problem is unique has Hausdorff dimension $2n-1$ (as a subset of R^{2n}) and that the set of n -point configurations in R^d for which there is a unique Steiner tree is path-connected.

The Gilbert–Steiner problem is a generalization of the Steiner tree problem on a specific optimal mass transportation. It is shown that a solution of the planar Gilbert–Steiner problem has no branching point of degree at least 4.

Chapter 4 is devoted to the problem of minimizing the maximal distance to a given compact set M among the sets of a given length ℓ . The maximal distance minimizers for a closed planar curve of a small enough curvature is found.

In Chapter 6 a conjecture of Simmons that every coloring of a 2-dimensional sphere of radius strictly greater than $1/2$ in three colors has a pair of monochromatic points at distance 1 apart is proven.

6. Conclusion

The dissertation presented complies with the requirements of the Law for development of academic personnel in Republic of Bulgaria and Regulations of BAS and IMI-BAS for applying the Law. The results obtained allow me to propose to the scientific Jury to award the scientific degree „Doctor of sciences” to Danila Cherkashin, PhD, in Area of higher education: 4. Natural Sciences, Mathematics and Informatics, Professional Field: 4.5. Mathematics.

26.04.2024

Signature:

Prof. Dr.Sci Emil Kolev