Semi-annual report of the department
of "Function Theory" for 2022

Scientific direction: Harmonic, nonharmonic analysis and approximation theory

Topic: "Approximation of functions of many variables by ridge functions, neural networks, linear and nonlinear superpositions, embedding theorems for functional spaces"

On scientific activity

In the report period, 5 works connecting 7 executors on the theme "Approximation of functions of many variables by ridge functions, neural networks, linear and nonlinear superpositions, and embedding theorems for functional spaces" were conducted. 2 papers were published. These articles were published in journals indexed in the databases Clarivate Analytics "Web of Science" and "Scopus". In addition, 2 articles were accepted for publication. 1 monograph was published by the American Mathematical Society.

About works

Work 1: Characterization of an extremal element in the problem of approximation by the sum of algebras

 (Executor: dr. math. sci. Vugar Ismailov and j.r.a. Aida Asgarova)

Published works:

1. Vugar E. Ismailov, "A formula for the approximation of functions by single hidden layer neural networks with weights from two straight lines", *Proc. Inst. Math. Mech. Natl. Acad. Sci. Azerb.* **48** (2022), no. 1, 140-149, (Clarivate Analytics ESCI)

https://proc.imm.az/volumes/48-1/48-01-12.pdf

2. Vugar E. Ismailov, Ridge functions and applications in neural networks. Mathematical Surveys and Monographs, 263. *American Mathematical Society, Providence, RI, 2021,* 186 pp.

The work submitted for publication:

1. Aida Asgarova, Ali Huseynli, Vugar Ismailov, "A Chebyshev type alternation theorem for best approximation by a sum of two algebras"

https://arxiv.org/abs/2204.07448

Work 2: Application of some inequalities obtained in Lebesgue-Morrie type spaces to the study of a class of differential equations

(Executors: dr. ph.-m. s., prof, Alik Najafov and PhD Aygun Omarova)

2 papers accepted for publication:

1. Alik M. Najafov, Sain T. Alekberli, "A solution of p-harmonic equations of fractional order", European Journal of Pure and Applied Mathematics.

2. Alik M. Najafov, Sain T. Alekberli, "On smoothness of solution of a class of p-harmonic type equations", Differential Equations and Applications.

Work 3: Approximations of singular integral transformations in some functional spaces and investigation of properties of discrete singular transformations (Executor: dr. math. sci. Rashid Aliev)

1 paper was published:

1. Aliev R.A., Ahmadova A.N. and Huseynli A.F., "Boundedness of the discrete Ahlfors-Beurling transform on discrete Morrey spaces ", *Proc. IMM NAS of Azerbaijan,* **48:1** (2022), 123-131, (Clarivate Analytics ESCI)

http://proc.imm.az/volumes/48-1/48-01-10.pdf

1 abstract was published:

1. Aliyev R.A., Hashimova F.V., "Properties of discrete Hilbert transform on discrete Orlich spaces", "Actual problems of mathematics and mechanics", Proceedings of the Republican scientific conference dedicated to the 99th anniversary of the birth of national leader of Azerbaijan Heydar Aliyev, Baku, Azerbaijan, May 11-13, 2022, pp. 34-36.

Work 4: Order estimates for the structural and constructive charactristics of periodic function derivatives with monotone Fourier coefficients (Executor: cand. ph.-m. s. Niyazi Ilyasov)

Work 5: Calculation of approximation error with RBF neural networks (Executors: cand. ph.-m. s. Ibrahim Maharov)

On scientific-organizational activity

Head of department Vugar Ismailov made a presentation on "On a Theorem of Hecht-Nielsen" at the institute seminar.

In the reporting period, the chief researcher of the department, dr. ph.-m. s., prof., Alik Najafov made a presentation on "Study of solutions of p-harmonic type equations in Grand Sobolev spaces" at the institute seminar.

Head of department Vugar Ismailov made a presentation on "Linear superpositions of functions and their application to neural networks" at the seminar "FIRST INTERNATIONAL BILATERAL WORKSHOP ON SCIENCE BETWEEN DOKUZ EYLÜL UNIVERSITY AND AZERBAIJAN NATIONAL ACADEMY OF SCIENCES".

Head of department Vugar Ismailov was a reviewer of the journals: Journal of Approximation Theory, Neural Networks, Transactions on Neural Networks and Learning Systems.

On February 2, 2022, a junior researcher of the department, Aida Asgarova, was awarded the "YOUNG SCIENTIST of the YEAR" award by the Institute of Mathematics and Mechanics of the National Academy of Sciences of Azerbaijan "For Effective Activity in the Field of Mathematical Sciences in 2021".

Head of the department   **dr.math.sc. Vugar Ismailov**