

International
Scientific Conference



Algebraic
and Geometric
Methods
of Analysis

27-30 May 2024
Odesa, Ukraine

The purpose of this conference is to bring together researchers in geometry, topology, algebra, analysis and dynamical systems and to provide for them a forum to present their recent work to colleagues from different nationalities. This way we aim to stimulate discussion about the latest findings in geometrical and topological methods in analysis and to increase international collaboration.

The conference continues the traditional annual conference «Geometry in Odesa» holding from 2004, and hosted by Odesa National University of Technology (Odesa National Academy of Food Technologies till 2021). From 2017 the conference was renamed to «Algebraic and geometric methods of analysis» (AGMA).

The Conference languages: Ukrainian and English.

LIST OF TOPICS

- Algebraic methods in geometry
- Differential geometry in the large
- Geometry and topology of differentiable manifolds
- General and algebraic topology
- Dynamical systems and their applications
- Geometric and topological methods in natural sciences
- Geometric problems in mathematical analysis

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Persistent interaction topology in data analysis

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Abstract. Topological data analysis, as a tool for extracting topological features and characterizing geometric shapes, has had tremendous success across diverse fields. Its key mathematical techniques include persistent homology and the recently developed persistent Laplacians. However, classic mathematical models like simplicial complexes often struggle to provide a localized topological description for interactions or individual elements within a complex system involving a specific set of elements. In this work, we introduce persistent interaction homology and persistent interaction Laplacian that emphasize individual interacting elements in the system. We demonstrate the stability of persistent interaction homology as a persistent module. Furthermore, for a finite discrete set of points in the Euclidean space, we provide the construction of persistent interaction Vietoris-Rips complexes and compute their interaction homology and interaction Laplacians. The proposed methods hold significant promise for analyzing heterogeneously interactive data and emphasizing specific elements in data. Their utility for data science is demonstrated with applications to molecules.

Reeb vector field as isometric embedding

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Considering **Sasaki metric** on the unit tangent bundle T_1M , a map $\xi : (M, g) \rightarrow (T_1M, G)$, defining by $\xi(x) = (x, \xi(x))$, is **isometric embedding** only if ξ is **parallel**. The rigidity of Sasaki metric motivates many authors consider various deformations of Sasaki metric (see [1, 5, 6, 7, 11]). In particular, Domenico Perrone [8] studied **Reeb vector fields** with respect to a **Riemannian g-natural metrics** on the unit tangent bundle.

A **Riemannian g-natural metric** [1, 2] on the unit tangent bundle T_1M is defined by

$$G_{(x,\xi)}(X^h, Y^h) = (a + c)g_x(X, Y) + dg_x(X, \xi)g_x(Y, \xi),$$

$$G_{(x,\xi)}(X^h, Y^v) = bg_x(X, Y),$$

$$G_{(x,\xi)}(X^v, Y^v) = ag_x(X, Y),$$

where $a, b, c, d = \text{const}$, $a > 0$.

A **contact metric manifold** is defined by a set (M, g, η, ξ, ϕ) , where M is a differential $2n + 1$ -dimensional manifold, ϕ is a tensor field of type $(1, 1)$, ξ is a vector field, η is 1-form satisfying

$$\eta(\xi) = 1, \quad \phi^2 = -I + \eta \otimes \xi,$$

G. Kuduk <i>Integral problem for system of partial differential equations of third order</i>	65
A. Kuramoto <i>The density of Borromean primes</i>	66
I. Kurbatova, N. Konovenko, M. Pistruil <i>Invariant transformation of generalized-recurrent-parabolic spaces that are in a quasi-geodesic mapping</i>	68
J. Lang <i>Notes on the Quality of Non-compactness for Non-compact Sobolev Embeddings</i>	70
D. Lehmann <i>Ordinary linear differential operators and connections. Application to curvilinear webs</i>	70
Jian Liu, Dong Chen, and Guo-Wei Wei <i>Persistent interaction topology in data analysis</i>	73
L. Lotarets <i>Reeb vector field as isometric embedding</i>	73
S. Maksymenko, M. Lysynskiy <i>Classification of smooth structures on line with two origins</i>	75
D. Maingi <i>Vector bundle construction via monads on multiprojective spaces</i>	77
O. Makarchuk <i>About one problem of the Gauss-Kuzmin type</i>	78
S. Maksymenko <i>Homotopy types of stabilizers of Morse-Bott functions on 3-manifolds</i>	79
M. Jinzenji, K. Kuwata <i>Elliptic Virtual Structure Constants and Generalizations of BCOV-Zinger Formula to Projective Fano Hypersurfaces</i>	80
B. Mazhar, S. Maksymenko <i>Deformation properties of smooth functions on Klein bottle</i>	80
Ł. Michalak <i>Algebraic periods of surface homeomorphisms</i>	82
H. Monaim <i>Wigner-Ville distribution associated with quadratic Clifford-Fourier transform</i>	82
P. Mormul <i>Non-simple strongly nilpotent distribution germs</i>	82
V. Mykhaylyuk <i>Extending of partial metrics</i>	83
C. L. Nehaniv <i>Axiomatic Development of Complexity Theory for Finite Groups</i>	84
M. Nesterenko <i>Construction and application of quasicrystals</i>	85
M. Nijjima <i>On Beloch's curve that appears when solving real cubic with origami</i>	87
Z. Novosad, A. Zagorodnyuk <i>Hypercyclicity of symmetric composition operator</i>	89
M. Nxumalo <i>On (i, j)-Baire Bilocales</i>	89
T. Obikhod <i>Application of the dynamical system theory for counting black hole entropy of microstates</i>	90