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

Organizers

- Ministry of Education and Science of Ukraine
- Odesa National University of Technology, Ukraine
- Institute of Mathematics of the National Academy of Sciences of Ukraine
- Taras Shevchenko National University of Kyiv
- Kyiv Mathematical Society

Scientific Committee

- **Vladimir Balan** (*Bucharest, Romania*)
- **Taras Banakh** (*Lviv, Ukraine*)
- **Dmytro Bolotov** (*Kharkiv, Ukraine*)
- **Vyacheslav Boyko** (*Kyiv, Ukraine*)
- **Yulia Fedchenko** (*Odesa, Ukraine*)
- **Oleg Gutik** (*Lviv, Ukraine*)
- **Olena Karlova** (*Chernivtsi, Ukraine*)
- **Volodymyr Kiosak** (*Odesa, Ukraine*)
- **Nadiia Konovenko** (*Odesa, Ukraine*)
- **Volodymyr Lyubashenko** (*Kyiv, Ukraine*)
- **Sergiy Maksymenko** (*Kyiv, Ukraine*)
- **Koji Matsumoto** (*Yamagata, Japan*)
- **Piotr Mormul** (*Warsaw, Poland*)
- **Maryna Nesterenko** (*Kyiv, Ukraine*)
- **Roman Popovych** (*Kyiv, Ukraine*)
- **Alexandr Prishlyak** (*Kyiv, Ukraine*)
- **Aleksandr Savchenko** (*Kherson, Ukraine*)

Organizing commitee

- **Nadiia Konovenko** (*Odesa, Ukraine*)
- **Yuliya Fedchenko** (*Odesa, Ukraine*)
- **Mykola Lysynskiy** (*Kyiv, Ukraine*)
- **Bohdan Mazhar** (*Kyiv, Ukraine*)
- **Sergiy Maksymenko** (*Kyiv, Ukraine*)
- **Alexandr Prishlyak** (*Kyiv, Ukraine*)

Persistent interaction topology in data analysis

Jian Liu
(Mathematical Science Research Center, Chongqing University of Technology, Chongqing 400054, China)
E-mail: liujia53@msu.edu

Dong Chen
(Department of Mathematics, Michigan State University, MI 48824, USA)
E-mail: chendo11@msu.edu

Guo-Wei Wei
(Department of Mathematics, Michigan State University, MI 48824, USA)
E-mail: weig@msu.edu

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

Liana Lotarets
(V.N. Karazin Kharkiv National University, Ukraine)
E-mail: lyanalotarets@gmail.com

Considering **Sasaki metric** on the unit tangent bundle T_1M, a map $\xi : (M,g) \to (T_1M,G)$, 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 $a,b,c,d = const$, $a>0$.

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

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