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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Structure of gradient bifurcations on compact 2-manifolds

Alexandr Prishlyak
(Taras Shevchenko National University of Kyiv)
E-mail: prishlyak@yahoo.com

Typical vector fields on compact 2-manifolds are Morse-Smale fields. Among the gradient fields are Morse fields or Morse-Smale gradient-like fields that do not contain closed trajectories. They satisfy three properties:

1) singular points are nondegenerate;
2) there are no saddle connections;
3) α-limit (ω-limit) set of each trajectory is a singular point.

In typical one-parameter field families, one of these conditions is violated. Violation of the first condition leads to a saddle-node bifurcation, and the second to the appearance of a saddle connection. The third condition cannot be violated in gradient fields.

Our main purpose is to describe the global topological structure of typical one-parameter bifurcations of gradient vector fields in the following situations: 1) on closed surfaces in the general situation, 2) on closed surfaces with a minimum number of singular points of the vector field, 3) on surfaces with an edge of a small kind .

To describe a Morse-Smale vector field on a closed surface, we use a cellular structure in which the cells are stable manifolds of singular points. Separatrices are trajectories belonging to one-dimensional stable and unstable manifolds of singular points.

A saddle-node bifurcation can be described as a change in the vector field in which one of the separatrices contracts to a point. If the node is a source, then a pair of cells is reduced in dimensions 0 and 1, and if a node is a sink, then in dimensions 1 and 2.

The saddle connrction bifurcation is described using a subgraph in the form of the letter T, in which one of the three edges is marked.

Chord diagrams are often used to describe the structure of optimal Morse flows (Morse flows with the smallest number of singular points on a given surface). We modify the chord diagram to describe typical gradient bifurcations: 1) for a saddle-node bifurcation using a pair of points on circular arcs, 2) for a saddle-node using a T-insert. In this case, all chords and edges of the T-insert are painted in two colors depending on the alignment of orientations.

Theorem 1. *Optimal saddle-node bifurcations have the same structure if and only if there is an isomorphism of their chord diagrams that preserves the colors of the chords and the location of the two selected points on the circle. For every framed chord diagram there is a corresponding bifurcation.*

Theorem 2. *Optimal saddle connection bifurcations have the same structure if and only if their chord diagrams with a T-insert are isomorphic. For each chord diagram with a T-insert there is a corresponding bifurcation.*

References

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[3] Bohdana Hladysh, Alexandr Prishlyak Deformations in the general position of the optimal functions on oriented surfaces with boundary. *Ukrainian Mathematical Journal*, 71: 1173–1185, 2020.