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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Lemma 2. *Let M be an oriented connected closed 3-manifold endowed with a very admissible link $\mathcal{L}$. Let $f : N \to M$ be a finite covering branched over a finite link $L_0 \subset \mathcal{L}$. Let $f_* : I_{N,f^{-1}(\mathcal{L})} \to I_{M,\mathcal{L}}$ denote the homomorphism induced by f. Then, we have*

$$f_*(\prod_{J \subset f^{-1}(\mathcal{L})} \mathbb{Z}[\mu_J]) \subset \prod_{K \subset \mathcal{L}} \mathbb{Z}[\mu_K].$$

Proposition 3. *Let M be an integer homology 3-shpere endowed with a very admissible link $\mathcal{L}$ and $[A] \in H_2(M, \mathcal{L})$. Then there is a finite sublink $L \subset \mathcal{L}$ such that $[A] \in H_2(M, L)$. We can write $[A] = \sum_{K \subset L} c_K[S_K]$ with $c_K \in \mathbb{Z}$. Let $\Delta_{M,\mathcal{L}}([A]) = (a_K)_{K \subset \mathcal{L}} \in I_{M,\mathcal{L}}$. Then we have the following formula:*

$$a_K = \begin{cases} c_K[\lambda_K] - (\sum_{K' \subset L \setminus K} \mathrm{lk}(K, K')c_{K'})[\mu_K] & (K \subset L) \\ -\sum_{K' \subset L} \mathrm{lk}(K, K')c_{K'}[\mu_K] & (K \subset \mathcal{L} \setminus L) \end{cases}$$

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A new Newton-type method and connections to Schroder theorem, Voronoi's diagrams, Newton's flows and the Riemann hypothesis

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The speaker has designed, very recently [4], a new Newton-type's method for root finding and optimization, which can be applied in any dimensions. The method is named Backtracking New Q-Newton's method (BNQN).

This talk concerns the application of this method to finding roots of a meromorphic function in 1 complex variable. I will present:

- The convergence guarantee theorem when applying BNQN to finding roots of meromorphic functions, from [5].

- The experiments from [4], which shows that usually the basins of attraction of BNQN are much more smooth than that of Newton's method. This is rather unexpected, given that BNQN depends on many seemingly random factors.

- The theorem from [2] which proves rigorously that the dynamics of BNQN, for finding roots of a polynomial of degree 2, is the same as the classical Schr̆oder's theorem for dynamics of Newton's method (except that BNQN is not chaotic on the boundary line).

- Experiments from [1] which reveal some surprising connections between BNQN and Voronoi's diagrams and Newton's flows.
- New results from [3] which connects the dynamics of BNQN and the Riemann hypothesis.

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Geometric and algebraic properties of dispersionless Nizhnik equation

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The dispersionless Nizhnik equation (see [1] for justifying this name)

$$u_{txy} = (u_{xx}u_{xy})_x + (u_{xy}u_{yy})_y \tag{1}$$

is the dispersionless limit of the symmetric Nizhnik equation, which is the potential equation of the Nizhnik system [3] in the symmetric case. The equation (1) has interesting geometric and algebraic properties. In particular, the maximal Lie invariance (pseudo)algebra $\mathfrak{g}$ of (1) is infinite-dimensional and is spanned by the vector fields

$$\begin{aligned}
&D^t(\tau) = \tau\partial_t + \tfrac{1}{3}\tau_t x\partial_x + \tfrac{1}{3}\tau_t y\partial_y - \tfrac{1}{18}\tau_{tt}(x^3+y^3)\partial_u, \quad D^{\rm s} = x\partial_x + y\partial_y + 3u\partial_u,\\
&P^x(\chi) = \chi\partial_x - \tfrac{1}{2}\chi_t x^2\partial_u, \quad P^y(\rho) = \rho\partial_y - \tfrac{1}{2}\rho_t y^2\partial_u,\\
&R^x(\alpha) = \alpha x\partial_u, \quad R^y(\beta) = \beta y\partial_u, \quad Z(\sigma) = \sigma\partial_u,
\end{aligned}$$

where τ, χ, ρ, α, β and σ run through the set of smooth functions of t. Moreover, the contact invariance (pseudo)algebra $\mathfrak{g}_{\rm c}$ of (1) coincides with the first prolongation of the algebra $\mathfrak{g}$.

The point- and contact-symmetry pseudogroups G and $G_{\rm c}$ of (1) were efficiently constructed in [1] by using the original version of the algebraic megaideal-based method suggested in [2]. The basic (necessary) method condition that the pushforward Φ_* of elements $\mathfrak{g}$ by any element Φ of G preserves any megaideal $\mathfrak{m}$ of $\mathfrak{g}$, $\Phi_*\mathfrak{m} \subseteq \mathfrak{m}$, is replaced in this version by a weaker but more