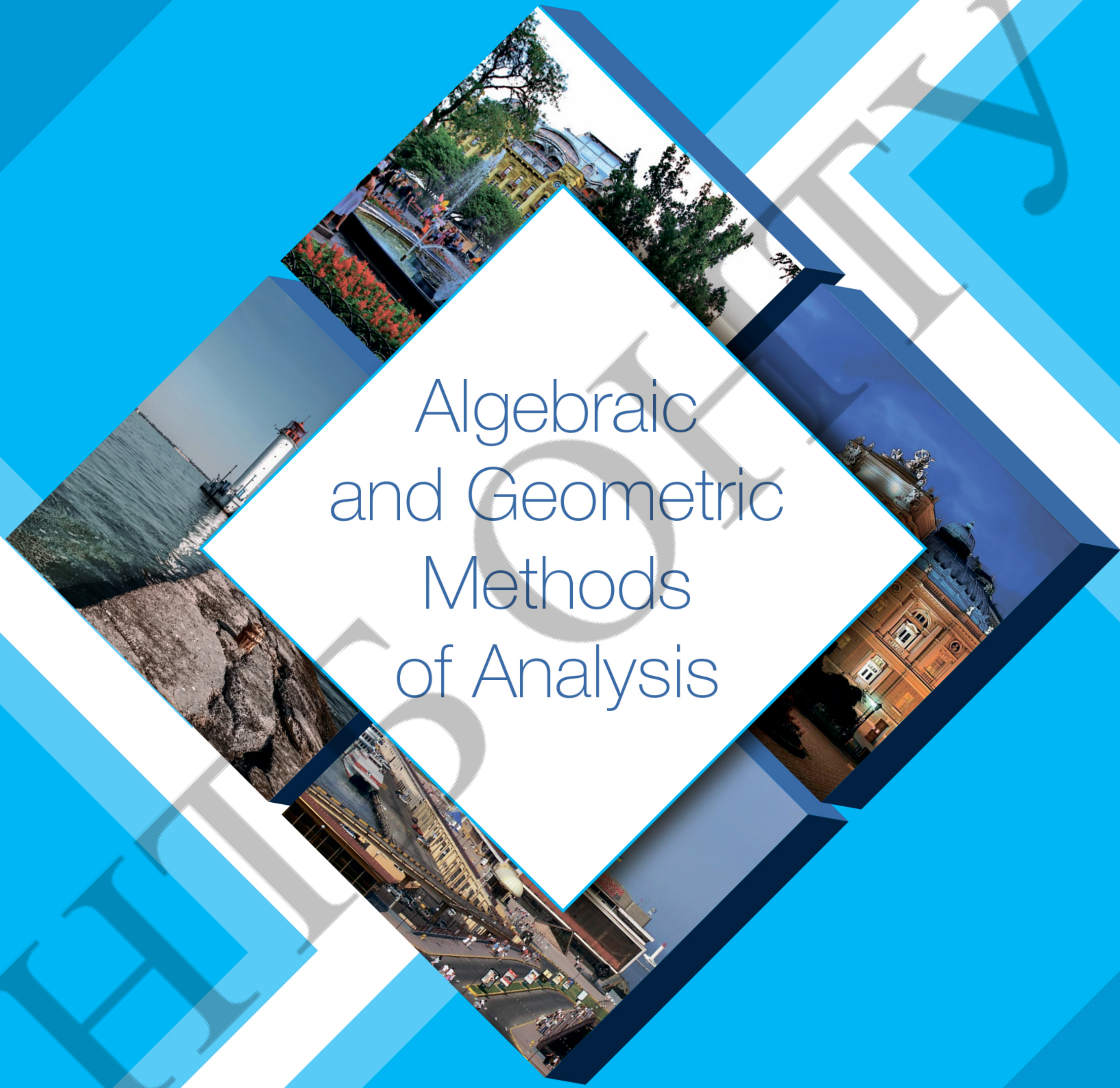
International Scientific Conference



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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$f(\gamma(b)) \in S(y_0, r_2)$, and $f(\gamma(t)) \in A(y_0, r_1, r_2)$ for any $a < t < b$. We say that f *satisfies the inverse Poletsky inequality at $y_0 \in f(D)$ with respect to p-modulus,* if the relation

$$M_p(\Gamma_f(y_0, r_1, r_2)) \leqslant \int\limits_A Q(y) \cdot \eta^p(|y - y_0|)\, dm(y) \tag{2}$$

holds for any $0 < r_1 < r_2 < r_0 := \sup\limits_{y \in f(D)} |y - y_0|$ and any Lebesgue measurable function $\eta : (r_1, r_2) \to [0, \infty]$ such that $\int\limits_{r_1}^{r_2} \eta(r)\, dr \geqslant 1$. A mapping $f : D \to \mathbb{R}^n$ is called *weakly light,* if, for any $y \in \mathbb{R}^n$, each connected component $\{f^{-1}(y)\}$ does not contain a non-degenerate path (see, e.g., Remark 8.3 in [2]).

Theorem 1. *Let $p > 1$, and let $f : D \to \mathbb{R}^n$ be a weakly light mapping which is differentiable a.e. and has Luzin N- and N^{-1}-properties with respect to the Lebesgue measure in $\mathbb{R}^n$, besides that, $f \in ACP_p(D)$. Let $y_0 \in \overline{f(D)} \setminus \{\infty\}$. Set*

$$K_{CT,p,y_0}(y, f) = \sum\limits_{x \in f^{-1}(y)} \frac{\left(\sup\limits_{|h|=1} \left|\left(f'(x)h, \frac{f(x)-y_0}{|f(x)-y_0|}\right)\right|\right)^p}{|J(x, f)|}\,. \tag{3}$$

Then f satisfies the inverse Poletsky inequality 2 at y_0 for $Q_*(y) := K_{CT,p,y_0}(y, f)$.

The result mentioned above is published in [3].

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[3] Sevost'yanov E., Targonskii V. On the Inverse Poletsky Inequality with a Cotangent Dilatation. *Comput. Methods Funct. Theory.* 2023. https://doi.org/10.1007/s40315-023-00495-3

Hasse norm theorem for 3-manifolds

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Abstract:Following the analogies between knots and primes, 3-manifolds and number rings in arithmetic topology, we show a topological analogue of the Hasse norm principle for finite cyclic coverings of 3-manifolds, which was originally stated for finite cyclic extensions of number fields.

Theorem 1. *Let M be an integral homology 3-sphere endowed with a very admissible link $\mathcal{L}$. Let $f : N \to M$ be a finite cyclic covering branched over a finite sublink L_0 of $\mathcal{L}$. Then,*

$$P_{M,\mathcal{L}} \cap f_*(I_{N,f^{-1}(\mathcal{L})}) = f_*(P_{N,f^{-1}(\mathcal{L})}).$$

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).