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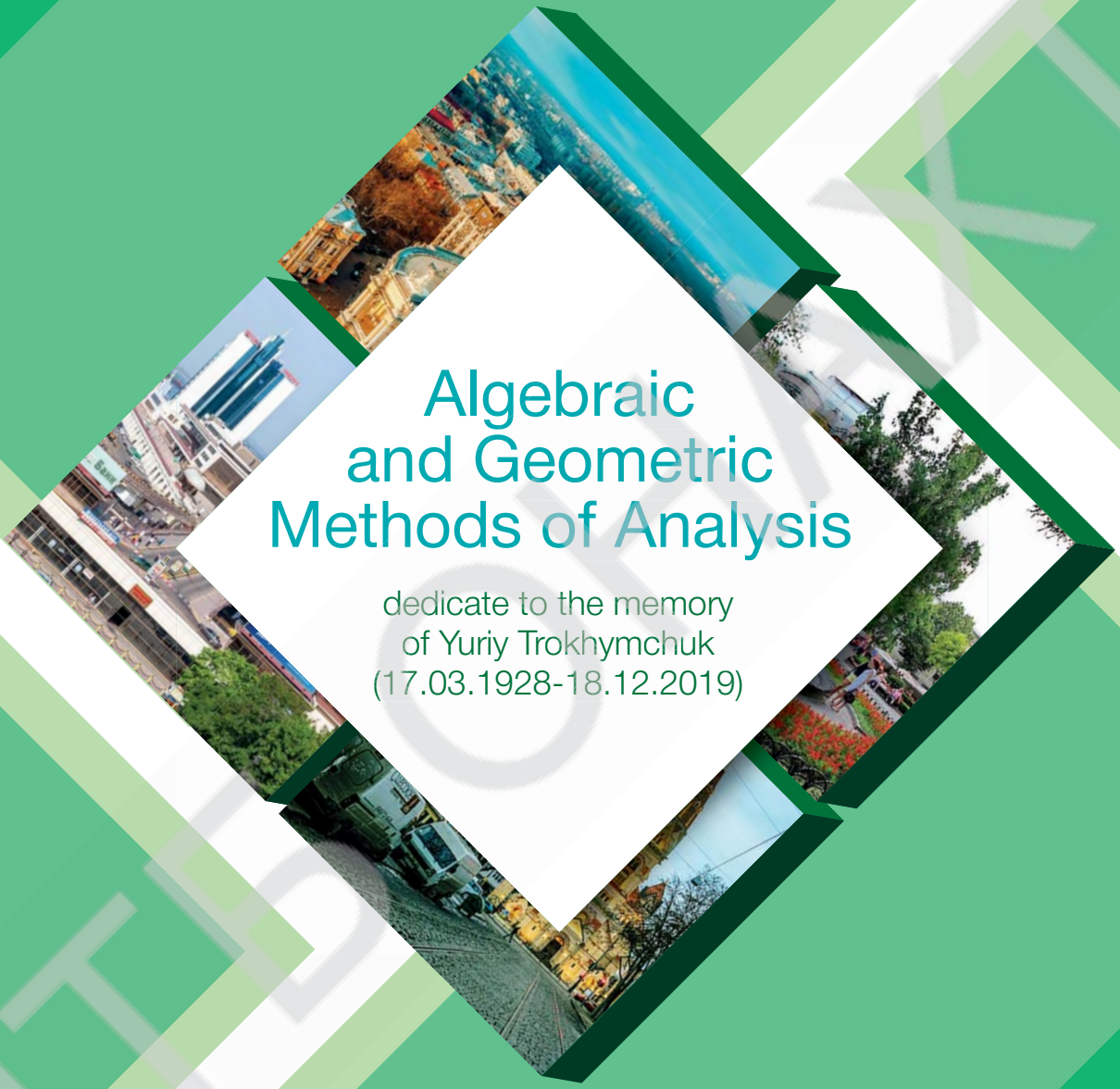

Algebraic and Geometric Methods of Analysis

dedicate to the memory
of Yuriy Trokhymchuk
(17.03.1928-18.12.2019)

May 25-28, 2021
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List of topics

- Topological methods in analysis
- Geometric problems of complex and mathematical analysis
- Algebraic methods in geometry
- Differential geometry in the whole
- Geometry and topology of differentiable manifolds
- General and algebraic topology
- Geometric and topological methods in natural sciences

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Inner harmonic measure for the fractional Laplacian

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The talk is based on [9], and it deals with the theory of potentials with respect to the α-Riesz kernel $|x-y|^{\alpha-n}$ of order $\alpha \in (0,2]$ on $\mathbb{R}^n$, $n \geqslant 3$. We first focus on the inner α-harmonic measure ε_y^A for $A \subset \mathbb{R}^n$ arbitrary, being motivated by the known fact that it is the main tool in solving the generalized Dirichlet problem for α-harmonic functions (see [1, 7]). Here ε_y is the unit Dirac measure at $y \in \mathbb{R}^n$, and μ^A the inner α-Riesz balayage of a Radon measure μ to $A \subset \mathbb{R}^n$ (see [8], cf. also [4] where $\alpha = 2$).

We describe the Euclidean support of the inner α-harmonic measure ε_y^A, provide a formula for evaluation of its total mass $\varepsilon_y^A(\mathbb{R}^n)$, establish the vague continuity of the map $y \mapsto \varepsilon_y^A$ outside the inner α-irregular points for A, and obtain necessary and sufficient conditions for ε_y^A to be of finite energy (more generally, for ε_y^A to be absolutely continuous with respect to inner capacity) as well as for $\varepsilon_y^A(\mathbb{R}^n) \equiv 1$ to hold. Those criteria are given in terms of newly defined concepts of inner α-thinness and inner α-ultrathinness of A at infinity (see [9]) that for $\alpha = 2$ and A Borel coincide with the concepts of outer 2-thinness at infinity by Doob [5] and Brelot [2], respectively.

Further, we extend some of these results to μ^A general by verifying the integral representation formula for inner balayage:

$$\mu^A = \int \varepsilon_y^A \, d\mu(y).$$

We also show that for every $A \subset \mathbb{R}^n$, there exists a K_σ-set $A_0 \subset A$ such that

$$\mu^A = \mu^{A_0} \quad \text{for all } \mu,$$

and give various applications of this theorem. In particular, we prove the vague and strong continuity of the inner swept, resp. inner equilibrium, measure under an approximation of A arbitrary, thereby strengthening Fuglede's result [6], established for A Borel.

Being mainly new even for $\alpha = 2$, the results obtained also present a further development of the theory of inner Newtonian capacities and of inner Newtonian balayage, originated by Cartan [3, 4].

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