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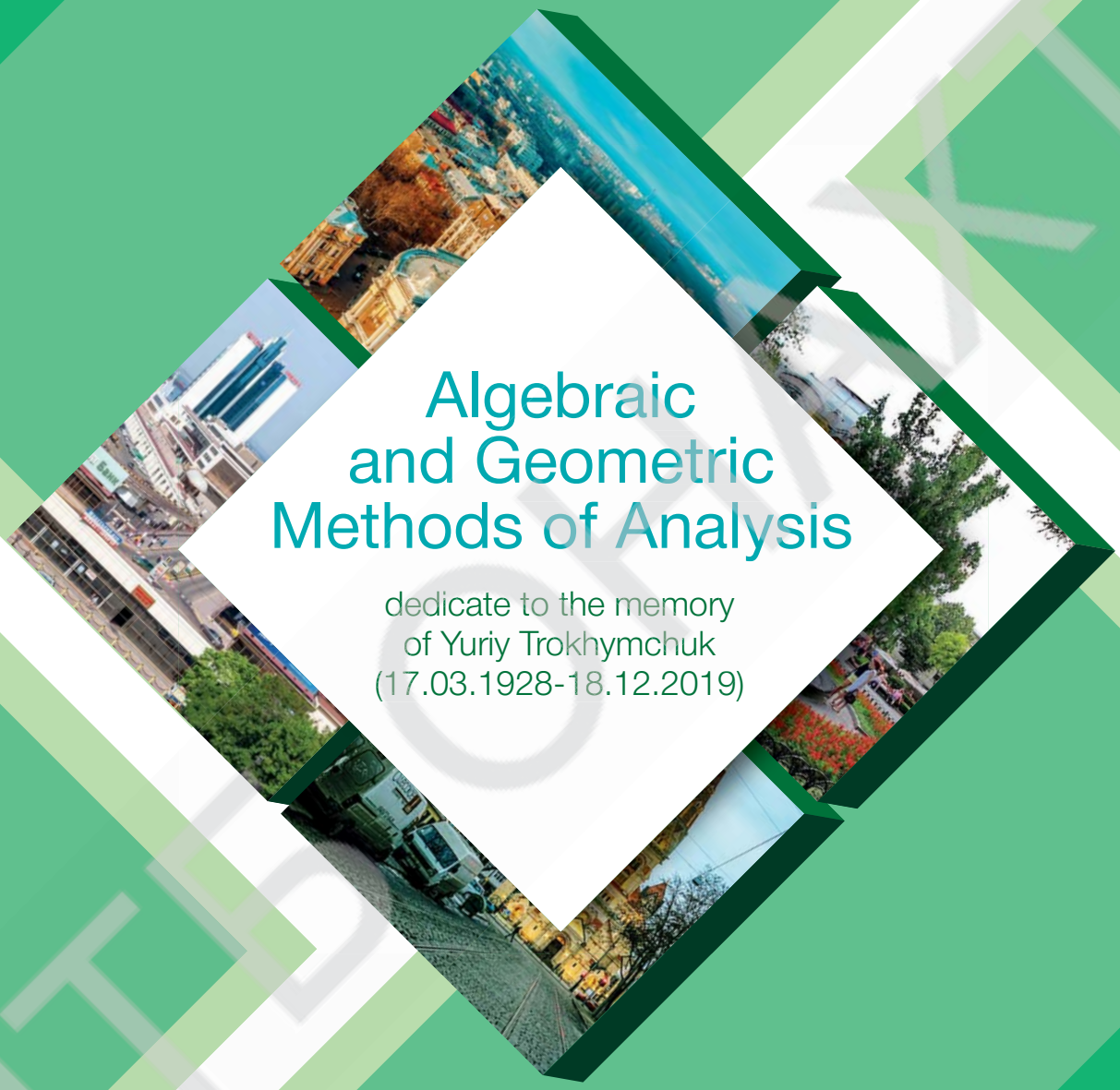

Algebraic and Geometric Methods of Analysis

dedicate to the memory
of Yuriy Trokhymchuk
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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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Deformations of circle-valued Morse functions on 2-torus

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Let M be a smooth compact surface, X be a closed (possible empty) subset of M. By P we also denote either $\mathbb{R}$ or S^1. The group $\mathcal{D}(M,X)$ of diffeomorphisms of M fixed on X acts from the right on the space of smooth maps $C^\infty(M,P)$ by the rule

$$\gamma : C^\infty(M,P)\times\mathcal{D}(M,X)\to C^\infty(M,P),\qquad \gamma(f,h)=f\circ h.$$

With respect to γ we denote by

$$\mathcal{S}(f,X)=\{h\in\mathcal{D}(M,X)\,|\,f\circ h=f\},$$
$$\mathcal{O}(f,X)=\{f\circ h\,|h\in\mathcal{D}(M,X)\}$$

the *stabilizer* and the *orbit* of $f\in C^\infty(M,P)$. Endow strong Whitney C^∞-topologies on $C^\infty(M,P)$ and $\mathcal{D}(M,X)$; then for a map $f\in C^\infty(M,P)$ these topologies induce some topologies on $\mathcal{S}(f,X)$ and $\mathcal{O}(f,X)$. We denote by $\mathcal{D}_{\mathrm{id}}(M,X)$ a connected component of the identity map $\mathcal{D}(M,X)$, and by $\mathcal{O}_f(f,X)$ a connected component of $\mathcal{O}(f,X)$ containing f. If $X=\varnothing$ we omit the symbol "$\varnothing$" from our notation.

To state our main result we need a notion of wreath product of groups of a special kind. Let G be a group, $n\geq 1$ be an integer. A semi-direct product $G^n\rtimes\mathbb{Z}$ with respect to a non-effective $\mathbb{Z}$-action α on G^n by cyclic shifts

$$\alpha(b_0,b_1,\dots,b_{n-1};k)=(b_k,b_{1+k},\dots,b_{n+k-1}),$$

where all indexes are taken modulo n, will be denoted by $G\wr_n\mathbb{Z}$ and called a *wreath product* of G with $\mathbb{Z}$ under n.

The following theorem is our main result.

Theorem 1 ([1]). *Let f be a function from $\mathcal{F}(T^2,P)$ with at least one critical point and whose Kronrod-Reeb graph contains a cycle. Then there exist a cylinder $Q\subset T^2$ such that $f|_Q: Q\to P$ is a Morse function, $n\in\mathbb{N}$ such that there is an isomorphism*

$$\pi_1\mathcal{O}_f(f)\cong\pi_0\mathcal{S}'(f|_Q,\partial Q)\wr_n\mathbb{Z},$$

where $\mathcal{S}'(f|_Q,\partial Q)=\mathcal{S}(f|_Q,\partial Q)\cap\mathcal{D}_{\mathrm{id}}(Q,\partial Q)$.

References

[1] Bohdan Feshchenko. Deformations of circle-valued Morse functions on 2-torus. Submitted to Proceedings of the International Geometry Center, arXiv2104.06151

Зміст