

International
Online Conference



**Algebraic
and Geometric
Methods of Analysis**

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

May 25-28, 2021
Odesa, Ukraine

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

Bohdan Feshchenko

(Institute of Mathematics of NAS of Ukraine)

E-mail: fb@imath.kiev.ua

Let M be a smooth compact surface, X be a closed (possibly 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

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

With respect to γ we denote by

$$\begin{aligned} \mathcal{S}(f, X) &= \{h \in \mathcal{D}(M, X) \mid f \circ h = f\}, \\ \mathcal{O}(f, X) &= \{f \circ h \mid h \in \mathcal{D}(M, X)\} \end{aligned}$$

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 $\mathcal{D}_{\text{id}}(M, X)$ 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 $X = \emptyset$ we omit the symbol “ \emptyset ” 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 $f|_Q : Q \rightarrow P$ 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 $\mathcal{S}'(f|_Q, \partial Q) = \mathcal{S}(f|_Q, \partial Q) \cap \mathcal{D}_{\text{id}}(Q, \partial Q)$.

REFERENCES

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

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