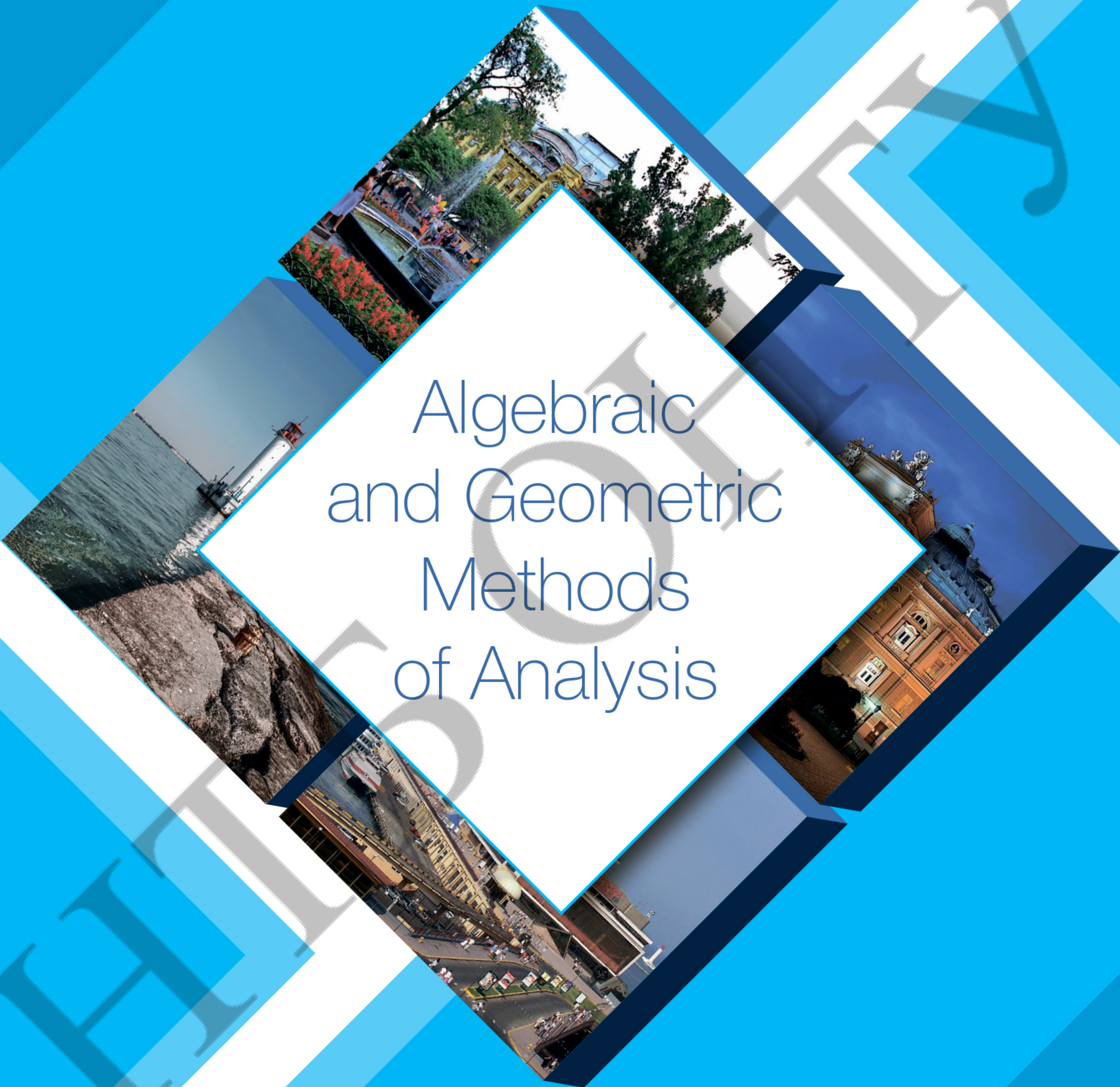
International
Scientific Conference



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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Then the higher homotopy groups of $\mathcal{S}(f)$ are n-powers of the corresponding 1-times higher homotopy groups of 2-sphere:

$$\pi_k \mathcal{S}(f) = \underbrace{\pi_{k+1} S^2 \times \cdots \times \pi_{k+1} S^2}_{n}, \quad k \geq 2.$$

In particular, if there are no such spheres and projective spaces, then $\mathcal{S}(f)$ is aspherical.

Elliptic Virtual Structure Constants and Generalizations of BCOV-Zinger Formula to Projective Fano Hypersurfaces

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In this talk, we propose a recipe for B-model computation of genus 1 Gromov-Witten invariants of Calabi-Yau and Fano Projective Hypersurfaces. Our formalism can be applied equally to both Calabi-Yau and Fano cases. In Calabi-Yau case, drastic cancellation of terms used in our formalism occurs and it results in another representation of BCOV-Zinger formula for projective Calabi-Yau hypersurfaces.

References

[1] M. Jinzenji, K. Kuwata. *Elliptic Virtual Structure Constants and Generalizations of BCOV-Zinger Formula to Projective Fano Hypersurfaces.* Preprint, arXiv:2404.07591.

Deformation properties of smooth functions on Klein bottle

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Let M be a connected compact C^∞-smooth 2-manifold. If $X \subset M$ is a closed subset of M, then $\mathcal{D}(M, X)$ denotes the group of diffeomorphisms of M, which are identity on X, endowed with the strong Whitney topology. If $X = \varnothing$, we omit X from notation. K denotes Klein bottle.

Consider space $C^\infty(M, \mathbb{R})$ endowed with the strong Whitney topology. Then the following right action of $\mathcal{D}(M, X)$ on $C^\infty(M, \mathbb{R})$ is defined: $C^\infty(M, \mathbb{R}) \times \mathcal{D}(M, X) \to C^\infty(M, \mathbb{R})$, $(f, h) \longmapsto f \circ h$. For each $f \in C^\infty(M, \mathbb{R})$, let $\mathcal{S}(f, X)$, $\mathcal{O}(f, X)$ be the stabilizer and the orbit of f with respect to that action. Let $\mathcal{D}_{\mathrm{id}}(M,X)$, $\mathcal{S}_{\mathrm{id}}(f,X)$ and $\mathcal{O}_f(f,X)$ be respective connected components of $\mathcal{D}(M,X)$, $\mathcal{S}(f,X)$, $\mathcal{O}(f,X)$ containing denoted subscripts. Also, we use notation $\mathcal{S}'(f,X) = \mathcal{S}(f) \cap \mathcal{D}_{\mathrm{id}}(M,X)$.

Proposition 1. *Let $f \in C^\infty(M,\mathbb{R})$ be such that every its germ in every its critical point is C^∞-equivalent to some homogeneous polynomial without multiple factors, and f is constant on the boundary components of M. Then there are three mutually exclusive possibilities:*

(a) *its Kronrod–Reeb graph Γ_f is acyclic, and there exists component α of some critical level set $f^{-1}(a)$ and open disks $D_1, \dots, D_m$ such that $K \setminus \alpha = \bigsqcup_{i=1}^m D_i$,*

(b) *Γ_f is acyclic, and there exists component β of some regular level set $f^{-1}(b)$ and open Möbius bands M_1, M_2 such that $K \setminus \beta = M_1 \bigsqcup M_2$,*

(c) *Γ_f has a cycle, and there exists component C of some regular level set $f^{-1}(c)$, corresponding to a point on the cycle, and open cylinders $Q_1, \dots, Q_m$ such that $K \setminus \{h(C) \mid h \in \mathcal{S}(f)\} = \bigsqcup_{i=1}^m Q_i$.*

Theorem 2. *In the case (b) of Proposition 1 there is an isomorphism*

$$\pi_1 \mathcal{O}_f(f) \cong \pi_0 \mathcal{S}(f|_{M_1}, \partial M_1) \times \pi_0 \mathcal{S}(f|_{M_2}, \partial M_2).$$

For Mobius band M group $\pi_0 \mathcal{S}(f|_M, \partial M)$ was computed in [1].

Let $C \subset K$ be a closed curve, that corresponds to point on the cycle of Γ_f. Let Q be the cylinder bounded by C and the next curve among $\{C_1 \equiv C, C_2, \dots, C_m\} = \{h(C) \mid h \in \mathcal{S}(f)\}$. Denote $G = \pi_1 \mathcal{O}(f|_Q, \partial Q)$, and let $G \wr_{m,\gamma} \mathbb{Z}$ be certain type of wreath product depending on γ.

Theorem 3. *In the case (c) of Proposition 1 there are two possibilities:*

(i) *either for every $h \in \mathcal{S}(f)$ equality $h(C) = C$ implies that h preserves orientation of C. Then there is an isomorphism*

$$\pi_1 \mathcal{O}_f(f) \cong G \wr_m \mathbb{Z},$$

and m can be only odd,

(ii) *or there exists $h \in \mathcal{S}(f)$ such that $h(C) = C$ and h changes orientation of C. Then exists an automorphism $\gamma\colon G \to G$ with $\gamma^2 = \mathrm{id}$ such that there is an isomorphism*

$$\pi_1 \mathcal{O}_f(f) \cong G \wr_{m,\gamma} \mathbb{Z}.$$

Theorem 4. *Consider composition $T^2 \xrightarrow{\pi} K \xrightarrow{f} \mathbb{R}$, where $f \in C^\infty(M,\mathbb{R})$ is the same as in Proposition 1, and π is the orientable double covering of Klein bottle with the torus. Then there are subgroups $\pi_0 \mathcal{S}'(f) \hookrightarrow \pi_0 \mathcal{S}'(f \circ \pi)$ and $\pi_1 \mathcal{O}_f(f) \hookrightarrow \pi_1 \mathcal{O}_{f\circ\pi}(f \circ \pi)$. Particularly, considering the respective cases of Theorem 3 holds the following:*

(i) $\pi_1 \mathcal{O}_f(f) \cong G \wr_m \mathbb{Z} \hookrightarrow G^2 \wr_m \mathbb{Z} \cong \pi_1 \mathcal{O}_{f\circ\pi}(f \circ \pi)$,

(ii) $\pi_1 \mathcal{O}_f(f) \cong G \wr_{m,\gamma} \mathbb{Z} \hookrightarrow G \wr_{2m} \mathbb{Z} \cong \pi_1 \mathcal{O}_{f\circ\pi}(f \circ \pi)$.

References

[1] Kuznietsova I., Maksymenko S. *Deformational symmetries of smooth functions on non-orientable surfaces*, Topol. Methods Nonlinear Anal., to appear, 2024. arXiv:2308.00577