International
Scientific Conference

Algebraic and Geometric Methods of Analysis

Devoted to 160 anniversary of
Dvytro Grave
(25.08.1863 - 19.12.1939)
Academician of the Ukrainian Academy of Sciences, the first director of the Institute of Mathematics of NAS of Ukraine

May 29 – June 1, 2023
Odesa, Ukraine

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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Homotopy type of stabilizers of functions with non-isolated singularities on surfaces

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Let M be a smooth compact surface, $\mathcal{D}(M)$ be a group of diffeomorphisms of M, and P be either $\mathbb{R}$ or S^1. For a smooth function $f : M \to P$ denote by $\mathcal{S}(f)$ a group of f-preserving diffeomorphisms of M, i.e.,

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

and by $\mathcal{S}_{\mathrm{id}}(f)$ a connected component of $\mathcal{S}(f)$ containing id_M.

In [1] the author considered the following class of functions $\mathcal{F}(M,P)$ and described the homotopy type of $\mathcal{S}_{\mathrm{id}}(f)$ for functions from it.

Definition 1. A smooth function $f \in C^\infty(M,P)$ on M belongs to the class $\mathcal{F}(M,P)$ if the following conditions are satisfied:

(1) for each connected component V of the boundary ∂M a function $f|_V$ either takes a constant value or is a covering map,

(2) a set of critical points Σ_f of f is a disjoint union of smooth submanifolds of M and $\Sigma_f \subset \mathrm{Int}(M)$,
(3) for each connected component C of Σ_f and each critical point $p \in C$ there exist a local chart $(U, \phi : U \to \mathbb{R}^2)$ near p and a chart $(V, \psi : V \to \mathbb{R})$ near $f(p) \in P$ such that $f(U) \subset V$ and a local representation $\psi \circ f \circ \phi^{-1} : \phi(U) \to \psi(V)$ of f is
   (a) either a homogeneous polynomial $f_p : \mathbb{R}^2 \to \mathbb{R}$ of degree $\deg f_p \geq 2$ having no multiple factors,
   (b) or is given by $f_C(x, y) = \pm y^{n_C}$ for some $n_C \in \mathbb{N}_{\geq 2}$ depending of C.

Note that the class $\mathcal{F}(M, P)$ contains the class of P-valued Morse-Bott functions on M.

Theorem 2 (Theorem 1.2 [1])**.** *For a function $f \in \mathcal{F}(M, P)$ the group $\mathcal{S}_{\mathrm{id}}(f)$ is contractible if f has at least one saddle or M is non-oriented, otherwise $\mathcal{S}_{\mathrm{id}}(f)$ is homotopy equivalent to S^1.*

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On direct limits of Minkowski's balls, domains, and their critical lattices

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We construct direct systems of Minkowski, Davis and Chebyshev-Cohn balls and domains, direct systems of their critical lattices and calculate their direct limits. By (general) Minkowski balls we mean (two-dimensional) balls in $\mathbb{R}^2$ of the form

$$D_p : \ |x|^p + |y|^p \leq 1, \ p \geq 1. \tag{1}$$

From the proof of Minkowski's conjecture [1, 2, 3, 4, 5, 8] in notations [8, 9] we have next expressions for critical determinants and their lattices:

Theorem 1. (1) $\Delta(D_p) = \Delta_p^{(0)} = \Delta(p, \sigma_p) = \frac{1}{2}\sigma_p, \ 2 \leq p \leq p_0;$
(2) $\sigma_p = (2^p - 1)^{1/p}$,
(3) $\Delta(D_p) = \Delta_p^{(1)} = \Delta(p, 1) = 4^{-\frac{1}{p}} \frac{1+\tau_p}{1-\tau_p}, \ 1 \leq p \leq 2, \ p \geq p_0,$
(4) $2(1 - \tau_p)^p = 1 + \tau_p^p, \ 0 \leq \tau_p < 1,$
where p_0 is a real number that is defined unique by conditions $\Delta(p_0, \sigma_p) = \Delta(p_0, 1), \ 2,57 < p_0 < 2,58, \ p_0 \approx 2.5725$
For their critical lattices respectively $\Lambda_p^{(0)}$, $\Lambda_p^{(1)}$ next conditions satisfy: $\Lambda_p^{(0)}$ and $\Lambda_p^{(1)}$ are two D_p-admissible lattices each of which contains three pairs of points on the boundary of D_p with the property that $(1, 0) \in \Lambda_p^{(0)}$, $(-2^{-1/p}, 2^{-1/p}) \in \Lambda_p^{(1)}$,

Denote by $V(D_p)$ the volume (area) of D_p.