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Online Conference



**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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On m -convexity and m -semiconvexity of sets in Euclidean spaces

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The topological and geometric properties of classes of generally convex sets in multidimensional real Euclidean space \mathbb{R}^n , $n \geq 2$, known as m -convex, weakly m -convex, m -semiconvex, and weakly m -semiconvex, $m = 1, 2, \dots, n-1$, are studied in [1]–[6]. A set of the space \mathbb{R}^n is called *m -convex* (*m -semiconvex*) if for any point of the complement of the set to the whole space there is an m -dimensional plane (half-plane) passing through this point and not intersecting the set. An open set of the space is called *weakly m -convex* (*weakly m -semiconvex*), if for any point of the boundary of the set there exists an m -dimensional plane (half-plane) passing through this point and not intersecting the given set. A closed set of the space is called *weakly m -convex* (*weakly m -semiconvex*) if it is approximated from the outside by a family of open weakly m -convex (weakly m -semiconvex) sets. These notions were proposed by Professor Yuri Zelinskii [1], [2].

Let us denote the classes of m -convex and weakly m -convex sets in \mathbb{R}^n , $n \geq 2$, by C_m^n and WC_m^n , respectively. There are weakly m -convex sets in \mathbb{R}^n , $n \geq 2$, $1 \leq m < n$, which are not m -convex, i. e., the class $WC_m^n \setminus C_m^n$ is not empty for any $m = 1, 2, \dots, n-1$. The example of an open set of the class $WC_1^2 \setminus C_1^2$ is constructed in [4]. The examples of open and closed sets of $WC_{n-1}^n \setminus C_{n-1}^n$ and examples of open sets of $WC_m^n \setminus C_m^n$, $n \geq 3$, $1 \leq m < n-1$, are constructed in [6]. Moreover, any open or compact set of $WC_{n-1}^n \setminus C_{n-1}^n$ is necessarily disconnected, but there exist domains of $WC_m^n \setminus C_m^n$, $n \geq 3$, $1 \leq m < n-1$, which show the following three theorems.

Theorem 1. ([4]) *An open set of the class $WC_{n-1}^n \setminus C_{n-1}^n$ consists of at least three connected components.*

Theorem 2. ([6]) *A compact set of the class $WC_{n-1}^n \setminus C_{n-1}^n$ consists of at least three connected components.*

Theorem 3. ([6]) *There exist domains of the class $WC_m^n \setminus C_m^n$, $n \geq 3$, $1 \leq m < n-1$.*

It is also known the topological classification of open (weakly) $(n-1)$ -convex sets in the space \mathbb{R}^n with smooth boundary [1], [4]. Each such a set is convex, or consists of no more than two unbounded connected components, or is given by the Cartesian product $E^1 \times \mathbb{R}^{n-1}$, where E^1 is a subset of \mathbb{R} .

Let us denote the classes of m -semiconvex and weakly m -semiconvex sets in \mathbb{R}^n , $n \geq 2$, by S_m^n and WS_m^n , respectively. In [3] it is constructed an example of an open set of the class $WS_1^2 \setminus S_1^2$. It is also conjectured that any open set of $WS_1^2 \setminus S_1^2$ consists of at least three components. The latter statement is proved in [4]. There can be also constructed sets of $WS_{n-1}^n \setminus S_{n-1}^n$ and the example of domains of $WS_m^n \setminus S_m^n$, $n \geq 3$, $1 \leq m < n-1$, similar to the domains of $WC_m^n \setminus C_m^n$. The following theorem shows the impossibility of the topological classification of weakly 1-semiconvex sets with smooth boundary similar to the topological classification of open $(n-1)$ -convex and weakly $(n-1)$ -convex sets with smooth boundary.

Theorem 4. ([5]) *An open, bounded set of the class $WS_1^2 \setminus S_1^2$ with smooth boundary consists of at least four connected components.*

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