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Algebraic and Geometric Methods of Analysis

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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 problems in mathematical analysis
- Geometric and topological methods in natural sciences

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ІНТЕРНАЦІОНАЛЬНИЙ ЦЕНТР СПІВРОБОТИ

On the behavior at infinity of one class of homeomorphisms

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Let Γ be a family of curves γ in \mathbb{R}^n , $n \geq 2$. A Borel measurable function $\rho : \mathbb{R}^n \rightarrow [0, \infty]$ is called *admissible* for Γ , (abbr. $\rho \in \text{adm } \Gamma$), if

$$\int_{\gamma} \rho(x) ds \geq 1$$

for any curve $\gamma \in \Gamma$. Let $p \in (1, \infty)$. The quantity

$$M_p(\Gamma) = \inf_{\rho \in \text{adm } \Gamma} \int_{\mathbb{R}^n} \rho^p(x) dm(x)$$

is called *p-modulus* of the family Γ .

For arbitrary sets E , F and G of \mathbb{R}^n we denote by $\Delta(E, F, G)$ a set of all continuous curves $\gamma : [a, b] \rightarrow \mathbb{R}^n$ that connect E and F in G , i.e., such that $\gamma(a) \in E$, $\gamma(b) \in F$ and $\gamma(t) \in G$ for $a < t < b$.

Let D be a domain in \mathbb{R}^n , $n \geq 2$, $x_0 \in D$ and $d_0 = \text{dist}(x_0, \partial D)$. Set

$$\mathbb{A}(x_0, r_1, r_2) = \{x \in \mathbb{R}^n : r_1 < |x - x_0| < r_2\},$$

$$S_i = S(x_0, r_i) = \{x \in \mathbb{R}^n : |x - x_0| = r_i\}, \quad i = 1, 2.$$

Let a function $Q : D \rightarrow [0, \infty]$ be Lebesgue measurable. We say that a homeomorphism $f : D \rightarrow \mathbb{R}^n$ is ring Q -homeomorphism with respect to p -modulus at $x_0 \in D$ if the relation

$$M_p(\Delta(fS_1, fS_2, fD)) \leq \int_{\mathbb{A}} Q(x) \eta^p(|x - x_0|) dm(x)$$

holds for any ring $\mathbb{A} = \mathbb{A}(x_0, r_1, r_2)$, $0 < r_1 < r_2 < d_0$, $d_0 = \text{dist}(x_0, \partial D)$ and for any measurable function $\eta : (r_1, r_2) \rightarrow [0, \infty]$ such that

$$\int_{r_1}^{r_2} \eta(r) dr = 1.$$

Denote by ω_{n-1} the area of the unit sphere

$$\mathbb{S}^{n-1} = \{x \in \mathbb{R}^n : |x| = 1\}$$

in \mathbb{R}^n and by

$$q_{x_0}(r) = \frac{1}{\omega_{n-1} r^{n-1}} \int_{S(x_0, r)} Q(x) dA$$

the integral mean over the sphere

$$S(x_0, r) = \{x \in \mathbb{R}^n : |x - x_0| = r\},$$

where dA is the element of the surface area. Let $L(x_0, f, R) = \sup_{|x - x_0| \leq R} |f(x) - f(x_0)|$.

Theorem 1. Suppose that $f : \mathbb{R}^n \rightarrow \mathbb{R}^n$ is a ring Q -homeomorphism with respect to p -modulus at a point x_0 with $p > n$ where x_0 is some point in \mathbb{R}^n and for some numbers $r_0 > 0$, $K > 0$ the condition

$$q_{x_0}(t) \leq K t^\alpha$$

holds for a.e. $t \in [r_0, +\infty)$. If $\alpha \in [0, p - n)$ then

$$\liminf_{R \rightarrow \infty} \frac{L(x_0, f, R)}{R^{\frac{p-n-\alpha}{p-n}}} \geq K^{\frac{1}{n-p}} \left(\frac{p-n}{p-n-\alpha} \right)^{\frac{p-1}{p-n}} > 0.$$

If $\alpha = p - n$ then

$$\liminf_{R \rightarrow \infty} \frac{L(x_0, f, R)}{(\ln R)^{\frac{p-1}{p-n}}} \geq K^{\frac{1}{n-p}} \left(\frac{p-n}{p-1} \right)^{\frac{p-1}{p-n}} > 0.$$

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