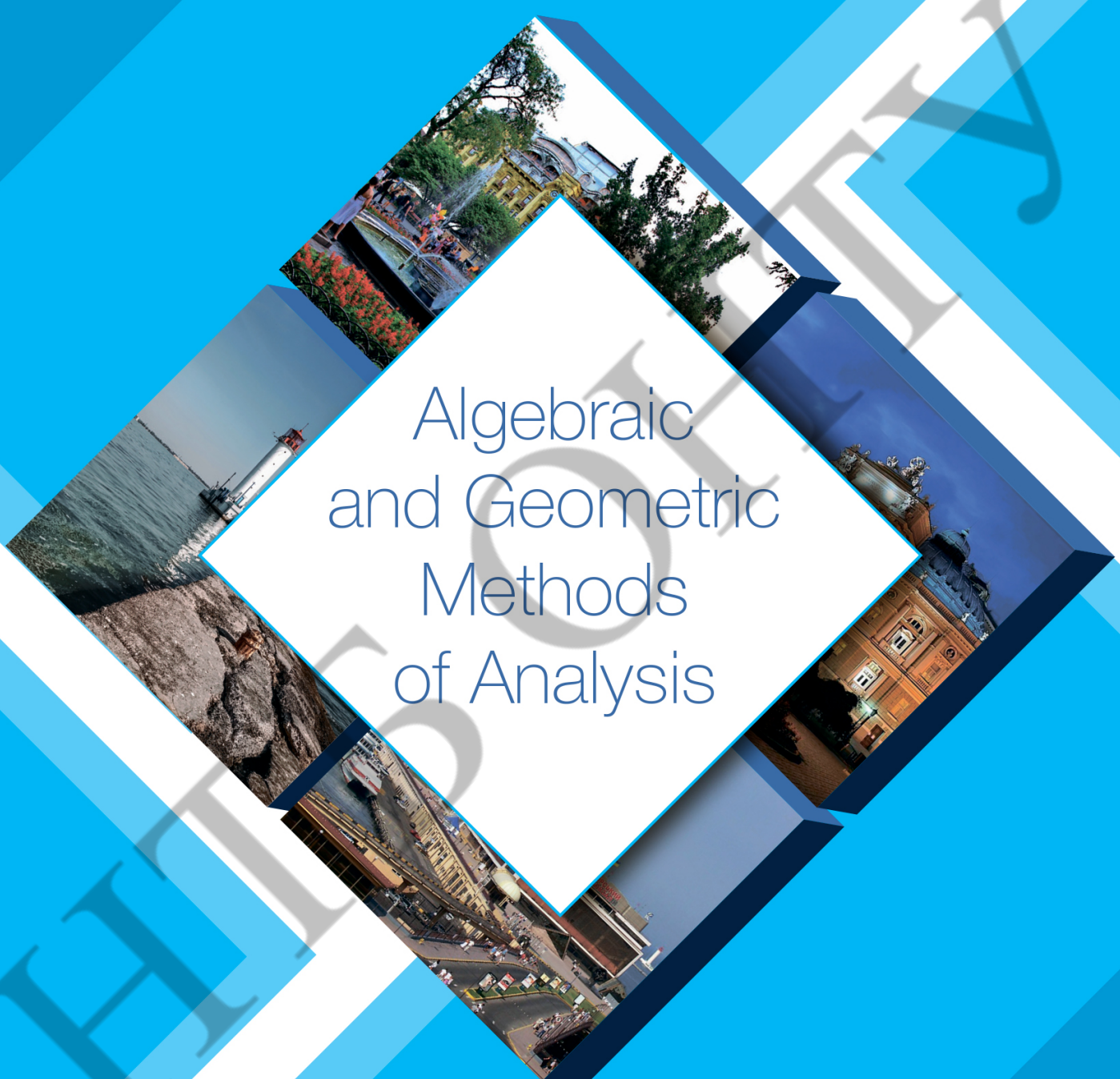


International  
Scientific Conference



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

#### ORGANIZERS

- Ministry of Education and Science of Ukraine
- Odesa National University of Technology, Ukraine
- Institute of Mathematics of the National Academy of Sciences of Ukraine
- Taras Shevchenko National University of Kyiv
- Kyiv Mathematical Society

#### SCIENTIFIC COMMITTEE

- |   |  |
|---|--|
| • <b>Vladimir Balan</b> ( <i>Bucharest, Romania</i> ) | • <b>Volodymyr Lyubashenko</b> ( <i>Kyiv, Ukraine</i> )  |
| • <b>Taras Banakh</b> ( <i>Lviv, Ukraine</i> )        | • <b>Sergiy Maksymenko</b> ( <i>Kyiv, Ukraine</i> )      |
| • <b>Dmytro Bolotov</b> ( <i>Kharkiv, Ukraine</i> )   | • <b>Koji Matsumoto</b> ( <i>Yamagata, Japan</i> )       |
| • <b>Vyacheslav Boyko</b> ( <i>Kyiv, Ukraine</i> )    | • <b>Piotr Mormul</b> ( <i>Warsaw, Poland</i> )          |
| • <b>Yulia Fedchenko</b> ( <i>Odesa, Ukraine</i> )    | • <b>Maryna Nesterenko</b> ( <i>Kyiv, Ukraine</i> )      |
| • <b>Oleg Gutik</b> ( <i>Lviv, Ukraine</i> )          | • <b>Roman Popovych</b> ( <i>Kyiv, Ukraine</i> )         |
| • <b>Olena Karlova</b> ( <i>Chernivtsi, Ukraine</i> ) | • <b>Alexandr Prishlyak</b> ( <i>Kyiv, Ukraine</i> )     |
| • <b>Volodymyr Kiosak</b> ( <i>Odesa, Ukraine</i> )   | • <b>Aleksandr Savchenko</b> ( <i>Kherson, Ukraine</i> ) |
| • <b>Nadiia Konovenko</b> ( <i>Odesa, Ukraine</i> )   |  |

#### ORGANIZING COMMITTEE

- |   |  |
|---|--|
| • <b>Nadiia Konovenko</b> ( <i>Odesa, Ukraine</i> ) | • <b>Bohdan Mazhar</b> ( <i>Kyiv, Ukraine</i> )      |
| • <b>Yuliya Fedchenko</b> ( <i>Odesa, Ukraine</i> ) | • <b>Sergiy Maksymenko</b> ( <i>Kyiv, Ukraine</i> )  |
| • <b>Mykola Lysynskiy</b> ( <i>Kyiv, Ukraine</i> )  | • <b>Alexandr Prishlyak</b> ( <i>Kyiv, Ukraine</i> ) |

- (1)  $M = S^1 \times [0, 1] = \{(z, s) \mid z \in \mathbb{C}, |z| = 1, 0 \leq s \leq 1\}$ , and  $f_0 : S^1 \times [0, 1] \rightarrow \mathbb{R}$  is given by  $f_0(\phi, s) = s$ ;
- (2)  $M = D^2 = \{(x, y) \in \mathbb{R}^2 \mid x^2 + y^2 \leq 1\}$ , and  $f_0 : D^2 \rightarrow \mathbb{R}$  is given by  $f_0(x, y) = \pm x^2 \pm y^2$ ;
- (3)  $M = S^2 = \{(x, y, z) \mid x^2 + y^2 + z^2 = 1\}$ , and  $f_0(x, y, z) : S^2 \rightarrow \mathbb{R}$  is given by  $f_0(x, y, z) = z$ ;
- (4)  $M = T^2 = \left\{ (x, y, z) \in \mathbb{R}^3 \mid \left( \sqrt{x^2 + y^2} - 2 \right)^2 + z^2 = 1 \right\}$ , and  $f_0 : T^2 \rightarrow \mathbb{R}$  is given by  $f_0(x, y, z) = z$ ;
- (5)  $M = T^2 = \{(w, z) \in \mathbb{C}^2 \mid |z| = |w| = 1\}$ , and  $f_0 : T^2 \rightarrow S^1$  is given by  $f_0(w, z) = z$ .

Obviously that functions from (1)–(4) belongs to  $\mathcal{F}^0(M, P)$ . They are height functions for (1)–(4), and a function from (5) is an angular projection. These functions have a minimum possible number of critical submanifolds, and we will call them *primitive functions*.

**Theorem 3.** *Let  $f$  be a smooth function from  $\mathcal{F}^0(M, P)$  and  $f_0 \in \mathcal{F}^0(M, P)$  be a primitive function. A function  $f$  admits a decomposition*

$$f = \varkappa \circ f_0 \circ h^{-1} \quad (1)$$

for some diffeomorphism  $h : M \rightarrow M$  and a smooth function  $\varkappa : \text{Im}(f_0) \rightarrow P$  satisfying the following conditions:

- (A)  $\varkappa$  has the only finite number of critical points in which it is not flat, i.e., not all derivatives of  $\varkappa$  at each critical point vanish,
- (B)  $\varkappa$  does not have extremes at  $f_0(\Sigma_{f_0}^0)$  and  $f_0(\partial M)$ .

In particular, if  $f \in \mathcal{F}^0(T^2, P)$  is null-homotopic, then  $f_0$  is given by (4), and by (5) otherwise. A factorization (1) is not unique and depends on the choice of  $h$ .

#### REFERENCES

- [1] Bohdan Feshchenko. Homotopy type of stabilizers of circle-valued functions with non-isolated singularities on surfaces, arXiv:2305.08255, 9 p., 2023
- [2] Sergiy Maksymenko. Deformations of functions on surfaces *Proceedings of Institute of Mathematics of NAS of Ukraine*, 17, no. 2 (2020) 150-199.

## Nonlinear interpolation of $\alpha$ -Holderian mappings with applications to quasilinear PDEs

Maria Rosaria Formica

(University of Napoli “Parthenope”, ITALY)

*E-mail:* mara.formica@uniparthenope.it

The Marcinkiewicz interpolation theorems for linear operators acting on Lebesgue spaces turned out to be a powerful tool for studying regularity of solutions for linear PDEs in  $L^p$ -spaces. The  $K$ -method introduced by J. Peetre ([5, 6]) allowed to extend the study of regularity of solutions of linear equations on spaces different from  $L^p$ -spaces. The main difficulty to apply Peetre’s definition is the identification of the interpolation spaces between two normed spaces embedded in a same topological space. In [2, 3, 4] we did such a study with applications to linear PDEs using new non-standard spaces as grand or small Lebesgue spaces and  $GT$ -gamma spaces.

In [7] L. Tartar gave interpolation results on nonlinear Hölderian mappings (which include Lipschitz mappings) and applied them to a variety of boundary value problems as bilinear applications, semi-linear PDEs but also on variational inequalities.

In this talk we present some results contained in the recent paper [1], where we extend Tartar’s results

on nonlinear interpolation of  $\alpha$ -Hölderian mappings  $\mathcal{T}$  by studying the action of the mappings  $\mathcal{T}$  on  $K$ -functionals and between interpolation spaces with logarithm functors. Therefore, we identify some interpolation spaces using couples of Lebesgue or Lorentz spaces, recovering spaces as Lorentz–Zygmund spaces or  $G\Gamma$ -gamma spaces.

We apply these results to obtain regularity on the gradient of the weak or entropic-renormalized solution  $u$  to quasilinear equations of the form

$$-\operatorname{div}(\widehat{a}(\nabla u)) + V(x; u) = f, \quad u = 0 \text{ on } \partial\Omega, \quad (1)$$

associated to the Dirichlet homogeneous condition on the boundary, where  $\Omega$  is a bounded smooth domain of  $\mathbb{R}^n$ ,  $\widehat{a}(\nabla u) = |\nabla u|^{p-2}\nabla u$ ,  $V$  is a nonlinear potential and  $f$  belongs to non-standard spaces like Lorentz–Zygmund spaces. We also show that the mapping  $\mathcal{T} : \mathcal{T}f = \nabla u$  is locally or globally  $\alpha$ -Hölderian under suitable values of  $\alpha$  and appropriate assumptions on  $V$  and  $\widehat{a}$ .

Furthermore, also the anisotropic version or the variable exponents version of the Laplacian are considered.

#### REFERENCES

- [1] Ahmed I., Fiorenza A., Formica M.R., Gogatishvili A., El Hamidi A., Rakotoson J.M., Quasilinear PDES, Interpolation spaces and Hölderian mappings, *Analysis Math.* **49** (4) (2023), 895-950.
- [2] Ahmed I., Fiorenza A., Formica M.R., Gogatishvili A., Rakotoson J.M., Some new results related to Lorentz  $G\Gamma$  spaces and interpolation, *J. Math. Anal. Appl.* **483** (2020), 123623.
- [3] Fiorenza A., Formica M.R., Gogatishvili A., Kopaliani K., Rakotoson J.M., Characterization of interpolation between grand, small or classical Lebesgue spaces, *Nonlinear Anal.* **177** (2018), 422-453.
- [4] Fiorenza A., Formica M.R., Rakotoson J.M., Pointwise estimates for  $G\Gamma$ -functions and applications, *Differential Integral Equations* **30** (2017), 809-824.
- [5] Peetre J., A theory of interpolation of normed spaces, *Notas de Matematica*, **39** (1968), 1-86.
- [6] Peetre J., A new approach in interpolation spaces, *Studia Math.* **34** (1970), 23-42.
- [7] Tartar L., Interpolation non linéaire et régularité, *J. Funct. Anal.*, **9** (1972), 469-489.

## Riemann Integration on a space with a fractal structure

**José F. Gálvez-Rodríguez**

(University of Almería)

*E-mail:* jgr409@ual.es

**Cristina Martín-Aguado**

(University of Almería)

*E-mail:* cristina\_martinaguado@yahoo.es

**Miguel A. Sánchez-Granero**

(University of Almería)

*E-mail:* misanche@ual.es

In this work we start developing a Riemann-type integration theory on spaces which are equipped with a fractal structure (see [1] for more details). The definition of a fractal structure is the next one:

**Definition 1.** A fractal structure  $\Gamma$  on a set  $X$  is a countable family of coverings  $\Gamma = \{\Gamma_n : n \in \mathbb{N}\}$  such that  $\Gamma_{n+1}$  is a strong refinement of  $\Gamma_n$  for each  $n \in \mathbb{N}$ .  $\Gamma_2$  is said to be a strong refinement of  $\Gamma_1$  if  $\Gamma_2$  is a refinement of  $\Gamma_1$  (that is, each element of  $\Gamma_2$  is contained in some element of  $\Gamma_1$ ) and for each  $B \in \Gamma_1$  it holds that  $B = \bigcup\{A \in \Gamma_2 : A \subseteq B\}$ . Cover  $\Gamma_n$  is called level  $n$  of the fractal structure.

<b>V. Dryuma</b> <i>6D-Riemannian metric associated at the Navier-Stokes equations and its applications</i>	<b>29</b>
<b>K. Eftekharinasab</b> <i>Interplay of Global Implicit Functions and Critical Point Theory in Infinite Dimensional Spaces</i>	<b>32</b>
<b>M. Egwe</b> <i>Spherical Analysis on Fuzzy Lie Groups</i>	<b>32</b>
<b>V. Fedorchuk, V. Fedorchuk</b> <i>On the construction and classification of the common invariant solutions for the <math>(1 + 3)</math>-dimensional Euler-Lagrange-Born-Infeld and homogeneous Monge-Ampere equations</i>	<b>33</b>
<b>B. Feshchenko</b> <i>Normal forms of functions with degenerate critical points on surfaces whose stabilizers are homotopically non-trivial</i>	<b>35</b>
<b>M. R. Formica</b> <i>Nonlinear interpolation of <math>\alpha</math>-Holderian mappings with applications to quasilinear PDEs</i>	<b>36</b>
<b>J.F. Gálvez-Rodríguez, C. Martín-Aguado, M.A. Sánchez-Granero</b> <i>Riemann Integration on a space with a fractal structure</i>	<b>37</b>
<b>I. Gkeneralis</b> <i>Topological rigidity of quoric manifolds</i>	<b>39</b>
<b>O. Gok</b> <i>On the multiplicative order convergence on Banach lattice <math>f</math>-algebras</i>	<b>41</b>
<b>M. Golasiński</b> <i>Octonionic Stiefel manifolds and vector bundles</i>	<b>43</b>
<b>T. Goy</b> <i>Some series involving central binomial coefficients</i>	<b>44</b>
<b>O. Gutik</b> <i>On non-topologizable semigroups</i>	<b>46</b>
<b>H. Chi</b> <i>Existence and non-existence of cohomogeneity one Einstein metrics</i>	<b>48</b>
<b>I. Havrylenko, E. Petrov</b> <i>Stability of vertical minimal surfaces in three-dimensional sub-Riemannian manifolds</i>	<b>50</b>
<b>O. Ye. Hentosh</b> <i>Rational factorization of Lax type flows in the space dual to the centrally extended Lie algebra of matrix super-integro-differential operators</i>	<b>52</b>
<b>O. Hukalov, V. Gordevskyy</b> <i>The some solution of the Bryan-Pidduck equation</i>	<b>54</b>
<b>S. Ivković</b> <i>Disjoint dynamical properties of wedge operators</i>	<b>55</b>
<b>R. Ilemobade, T.G. Jaiyeola</b> <i>On semi-symmetric <math>(\alpha, \beta, \gamma)</math>-inverse quasigroup</i>	<b>55</b>
<b>O. Karlova</b> <i>About Rolewicz theorem on inversion of continuous bijection between <math>F</math>-spaces</i>	<b>57</b>
<b>L. Fardigola, K. Khalina</b> <i>On boundary controllability problems for the heat equation with variable coefficients on a half-axis</i>	<b>58</b>
<b>N. Kitazawa</b> <i>On explicit reconstruction of real algebraic maps locally like moment maps</i>	<b>60</b>
<b>S.D. Koval, R.O. Popovych</b> <i>Group classification of Kolmogorov backward equations with power diffusivity</i>	<b>63</b>