

MULTI-DIMENSIONAL HARDY TYPE INEQUALITIES IN HÖLDER SPACES

EVGENIYA BURTSEVA, STAFFAN LUNDBERG, LARS-ERIK PERSSON AND
NATASHA SAMKO

Abstract. Most Hardy type inequalities concern boundedness of the Hardy type operators in Lebesgue spaces. In this paper we prove some new multi-dimensional Hardy type inequalities in Hölder spaces.

Mathematics subject classification (2010): 46E15, 26D15, 47B38.

Keywords and phrases: Inequalities, Hardy type inequalities, Hölder spaces, Hardy type operators, boundedness, compactification.

REFERENCES

- [1] E. BURTSEVA AND N. SAMKO, *Weighted Adams type theorem for the Riesz fractional integral in generalized Morrey space*, Fract. Calc. Appl. Anal. **19** (4): 954–972, 2016.
- [2] G. H. HARDY, *Notes on some points in the integral calculus, LX. An inequality between integrals*, Messenger of Math. **54**: 150–156, 1925.
- [3] G. H. HARDY, *Notes on some points in the integral calculus, LXIV*, Messenger of Math. **57**: 12–16, 1928.
- [4] G. H. HARDY, J. E. LITTLEWOOD, AND G. POLYA, *Inequalities*, Cambridge Univ. Press, 1934.
- [5] V. KOKILASHVILI, A. MESKHI, AND L.E. PERSSON, *Weighted Norm Inequalities for Integral Transforms with Product Weights*, Nova Scientific Publishers, Inc., New York, 2010.
- [6] A. KUFNER, L. MALIGRANDA, AND L.E. PERSSON, *The Hardy Inequality - About its History and Some Related Results*, Vydavatel'sky Servis Publishing House, Pilsen, 2007.
- [7] A. KUFNER, L.E. PERSSON, AND N. SAMKO, *Weighted Inequalities of Hardy Type*, second edition, World Scientific Publishing Co. Inc., River Edge, NY, 2017.
- [8] L. LEINDLER, *A note on embedding of classes H^ω* , Analysis Mathematica **27**: 71–76, 2001.
- [9] D. LUKKASSEN, L. E. PERSSON, AND N. SAMKO, *Hardy type operators in local vanishing Morrey spaces on fractal sets*, Fract. Calc. Appl. Anal. **18** (5): 1252–1276, 2015.
- [10] S. LUNDBERG AND N. SAMKO, *On some hyperbolic type equations and weighted anisotropic Hardy operators*, Math. Methods Appl. Sci., doi:10.1002/mma.4062, 2016.
- [11] S. M. NIKOL'SKI, *Priblizhenie funktsii mnogikh peremennykh i teoremy vlozeniya*, (Russian) [Approximation of functions of several variables and imbedding theorems] second edition, revised and supplemented, Nauka, Moscow, 1977.
- [12] L. E. PERSSON AND N. SAMKO, *Some remarks and new developments concerning Hardy-type inequalities*, Rend. Circ. Mat. Palermo, serie I, **82** (4): 1–29, 2010.
- [13] L. E. PERSSON AND N. SAMKO, *Weighted Hardy and potential operators in the generalized Morrey spaces*, J. Math. Anal. Appl. **377**: 792–806, 2011.
- [14] N. SAMKO, *On compactness of Integral Operators with a Generalized Weak Singularity in Weighted Spaces of Continuous Functions with a Given Continuity Modulus*, Proc. A. Razmadze Math. Inst. **136**: 91–113, 2004.
- [15] N. SAMKO, *Weighted Hardy and singular operators in Morrey spaces*, J. Math. Anal. Appl. **350**: 56–72, 2009.
- [16] N. SAMKO, *Weighted Hardy operators in the local generalized vanishing Morrey spaces*, Positivity **17** (3): 683–706, 2013.

- [17] S. G. SAMKO, A. A. KILBAS, AND O. I. MARICHEV, *Fractional Integrals and Derivatives, Theory and Applications*, London-New York: Gordon & Breach, Sci. Publ., (Russian edition – *Fractional Integrals and Derivatives and some of their Applications*, Minsk: Nauka i Tekhnika, 1987.), 1993, 1012 pages.
- [18] S. B. STECHKIN, *On the order of the best approximations of continuous functions*, Izv. Akad. Nauk SSSR Ser. Mat. **15** (3): 219–242, 1951.
- [19] C. TANG AND R. ZHOU, *Boundedness of weighted Hardy operator and its adjoint on Triebel-Lizorkin-type spaces*, J. Funct. Spaces Appl. **2012**, Article ID 610649.