

A NEW HILBERT-TYPE INEQUALITY IN THE WHOLE PLANE

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Abstract. By means of the weight coefficients and the idea of introduced parameters, a new discrete Hilbert-type inequality in the whole plane is given, which is an extension of Hardy-Hilbert's inequality. The equivalent form is obtained. The equivalent statements of the best possible constant factor related to several parameters, the operator expressions and a few particular inequalities are considered.

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REFERENCES

- [1] V. ADIYASUREN, T. BATBOLD, M. KRNIĆ, Hilbert-type inequalities involving differential operators, the best constants and applications, Math. Inequal. Appl., 18 (1) (2015), 111–124.
- [2] L. E. AZAR, The connection between Hilbert and Hardy inequalities, Journal of Inequalities and Applications, 2013: 452, 2013.
- [3] M. FAYE HAJIN COYLE, Calculus Course (sec. vol.), Bingjin, Higher Education Press, 2006: 397.
- [4] G. H. HARDY, J. E. LITTLEWOOD AND G. POLYA, *Inequalities*, Cambridge University Press, Cambridge, 1934.
- [5] B. HE, A multiple Hilbert-type discrete inequality with a new kernel and best possible constant factor, Journal of Mathematical Analysis and Applications, 431 (2015), 990–902.
- [6] L. P. HE, H. Y. LIU, B. C. YANG, Parametric Mulholland-type inequalities, Journal of Applied Analysis and Computation, 9 (5) (2019), 1973–1986.
- [7] Y. HONG, On the structure character of Hilbert's type integral inequality with homogeneous kernel and applications, Journal of Jilin University (Science Edition), **55** (2) (2017), 189–194.
- [8] Y. HONG, B. HE, B. C. YANG, Necessary and sufficient conditions for the validity of Hilbert type integral inequalities with a class of quasi-homogeneous kernels and its application in operator theory, Journal of Mathematics Inequalities, 12 (3) (2018), 777–788.
- [9] Y. HONG, Q. L. HUANG, B. C. YANG, J. Q. LIAO, The necessary and sufficient conditions for the existence of a kind of Hilbert-type multiple integral inequality with the non-homogeneous kernel and its applications, Journal of Inequalities and Applications (2017), 2017: 316.
- [10] Y. HONG, Y. M. WEN, A necessary and Sufficient condition of that Hilbert type series inequality with homogeneous kernel has the best constant factor, Annals Mathematica, 37A (3) (2016), 329–336.
- [11] Q. L. HUANG, A new extension of Hardy-Hilbert-type inequality, Journal of Inequalities and Applications (2015), 2015: 397.
- [12] X. S. HUANG, R. C. LUO, B. C. YANG, On a new extended Half-discrete Hilbert's inequality involving partial sums, Journal of Inequalities and Applications (2020) 2020: 16.
- [13] Z. X. HUANG, B. C. YANG, Equivalent property of a half-discrete Hilbert's inequality with parameters, Journal of Inequalities and Applications (2018) 2018: 333.
- [14] Z. X. HUANG, B. C. YANG, On a half-discrete Hilbert-type inequality similar to Mulholland's inequality, Journal of Inequalities and Applications, 2013: 290, 2013.
- [15] M. KRNIĆ, J. PEČARIĆ, General Hilbert's and Hardy's inequalities, Mathematical inequalities and applications, 8 (1) (2005), 29–51.
- [16] J. C. KUANG, Applied inequalities, Shangdong Science and Technology Press, Jinan, China (2004).



- [17] J. C. KUANG, Real analysis and functional analysis (continuation) (sec. vol.), Higher Education Press, Beijing, China (2015).
- [18] J. Q. LIAO, S. H. WU, B. C. YANG, On a new half-discrete Hilbert-ttpe inequality involving the variable upper limit integral and the partial sum, Mathematics, 2020, 8, 229, doi:10.3390/math8020229.
- [19] H. M. Mo, B. C. YANG, On a new Hilbert-type integral inequality involving the upper limit functions, Journal of Inequalities and Applications (2020) 2020: 5.
- [20] I. PERIĆ, P. VUKOVIĆ, Multiple Hilbert's type inequalities with a homogeneous kernel, Banach Journal of Mathematical Analysis, 5 (2) (2011), 33–43.
- [21] M. TH. RASSIAS, B. C. YANG, A multidimensional half-discrete Hilbert-type inequality and the Riemann zeta function, Applied Mathematics and Computation, 225 (2013), 263–277.
- [22] M. TH. RASSIAS, B. C. YANG, On a multidimensional half-discrete Hilbert-type inequality related to the hyperbolic cotangent function, Applied Mathematics and Computation, 242 (2013), 800–813.
- [23] M. TH. RASSIAS, B. C. YANG, On half-discrete Hilbert's inequality, Applied Mathematics and Computation, 220 (2013), 75–93.
- [24] A. Z. WANG, B. C. YANG, Q. CHEN, Equivalent properties of a reverse's half-discret Hilbert's inequality, Journal of Inequalities and Applications (2019) 2019: 279.
- [25] Z. T. XIE, Z. ZENG, Y. F. SUN, A new Hilbert-type inequality with the homogeneous kernel of degree -2, Advances and Applications in Mathematical Sciences, 12 (7) (2013), 391–401.
- [26] D. M. XIN, A Hilbert-type integral inequality with the homogeneous kernel of zero degree, Mathematical Theory and Applications, 30 (2) (2010), 70–74.
- [27] D. M. XIN, B. C. YANG, A. Z. WANG, Equivalent property of a Hilbert-type integral inequality related to the beta function in the whole plane, Journal of Function Spaces, Vol. 2018, Article ID2691816, 8 pages.
- [28] J. S. Xu, Hardy-Hilbert's inequalities with two parameters, Advances in Mathematics, 36 (2) (2007), 63–76.
- [29] B. C. YANG, A note on Hilbert's integral inequality, Chinese Quarterly Journal of Mathematics, 13 (4) (1998), 83–86.
- [30] B. C. YANG, *Hilbert-type integral inequalities*, Bentham Science Publishers Ltd., The United Arab Emirates (2009).
- [31] B. C. YANG, On Hilbert's integral inequality, J. Math. Anal. and Appl., 220 (1998), 778–785.
- [32] B. C. YANG, *The norm of operator and Hilbert-type inequalities*, Science Press, Beijing, China (2009).
- [33] B. C. YANG, L. DEBNATH, Half-discrete Hilbert-type inequalities, World Scientific Publishing, Singapore (2014).
- [34] B. C. YANG, M. F. HAUANG, Y. R. ZHONG, On an extended Hardy-Hilbert's inequality in the whole plane, Journal of Applied Analysis and Computation, 9 (6) (2019), 2124–2136.
- [35] B. C. YANG, M. F. HUANG, AND Y. R. ZHONG, Equivalent statements of a more accurate extended Mulholland's inequality with a best possible constant factor, Mathematical Inequalities and Applications, 23 (1) (2020), 231–44.
- [36] B. C. YANG, M. KRNIC, A half-discrete Hilbert-type inequality with a general homogeneous kernel of degree 0, Journal of Mathematical Inequalities, 6 (3) (2012), 401–417.
- [37] B. C. YANG, S. H. WU, Q. CHEN, On an extended Hardy-Littlewood-Polya's inequality, AIMS Mathematics, 5 (2) (2020), 1550–1561.
- [38] B. C. YANG, S. H. WU, J. Q. LIAO, On a new extended Hardy-Hilbert's inequality with parameters, Mathematics, 2020, 8, 73, doi:10.3390/math8010073.
- [39] B. C. YANG, S. H. Wu, A. Z. WANG, On a reverse half-discrete Hardy-Hilbert's inequality with parameters, Mathematics, 2019, 7, 1054.
- [40] M. F. YOU, On an extension of the discrete Hilbert inequality, Journal of Wuhan University (Nat. Sci. Ed.), doi:10.14188/j, 1671–8836, 2020, 0064.
- [41] Z. ZHEN, K. RAJA RAMA GANDHI, Z. T. XIE, A new Hilbert-type inequality with the homogeneous kernel of degree -2 and with the integral, Bulletin of Mathematical Sciences and Applications, 3 (1) (2014), 11–20.