## IMPROVEMENTS OF GENERALIZED HÖLDER'S INEQUALITIES AND THEIR APPLICATIONS

## JING-FENG TIAN, MING-HU HA AND CHAO WANG

**Abstract.** In this paper, we present some new improvements of generalized Hölder's inequalities, and then we obtain a new refinement of Minkowski inequality. Moreover, the obtained results are used to improve Chung's inequality and Beckenbach-type inequality proposed by Wang.

Mathematics subject classification (2010): 26D15, 26D10.

Keywords and phrases: Hölder's inequality, Minkowski inequality, Beckenbach-type inequality, Chung's inequality.

## REFERENCES

- [1] H. AGAHI, R. MESIAR, *Probability inequalities for decomposition integrals*, J. Comput. Appl. Math. **315** (2017), 240–248.
- [2] H. AGAHI, Y. OUYANG, R. MESIAR, E. PAP, M. ŠTRBOJA, Hölder and Minkowski type inequalities for pseudo-integral, Appl. Math. Comput. 217 (2011), 8630–8639.
- [3] H. AGAHI, R. MESIAR, Y. OUYANG, On some advanced type inequalities for Sugeno integral and T-(S-)evaluators, Inform. Sci. 190 (2012), 64–75.
- [4] E. F. BECKENBACH, On Hölder's inequality, J. Math. Anal. Appl. 15 (1966), 21–29.
- [5] E. F. BECKENBACH, R. BELLMAN, *Inequalities*, Springer-Verlag, Berlin, (1983).
- [6] K. L. CHUNG, Proposed Problem E1025, Amer. Math. Monthly 59 (1952), 407–408.
- [7] K. J. FALCONER, A Hölder-type inequality on a regular rooted tree, J. Math. Anal. Appl. 423 (2015), 913–923.
- [8] J. KUANG, Applied Inequalities, Shandong Science Press, Jinan, (2010).
- [9] S. MEDIĆ, T. GRBIĆ, A. PEROVIĆ, S. NIKOLIČIĆ, Inequalities of Hölder and Minkowski type for pseudo-integrals with respect to interval-valued ⊕-measures, Fuzzy Set. Syst. 304 (2016), 110–130.
- [10] J.-F. TIAN, New property of a generalized Hölder's inequality and its applications, Inform. Sci. 288 (2014), 45–54.
- [11] J.-F. TIAN, M.-H. HA, Properties of generalized sharp Hölder's inequalities, J. Math. Inequal. 11 (2017), 511–525.
- [12] J.-F. TIAN, M.-H. HA, Properties and refinements of Aczél-type inequalities, J. Math. Inequal. 12 (2018), 175–189.
- [13] J.-F. TIAN, M.-H. HA, Extensions of Hölder-type inequalities on time scales and their applications, J. Nonlinear Sci. Appl. 10 (2017), 937–953.
- [14] J.-F. TIAN, W. PEDRYCZ, New refinements of generalized Hölder's inequality and their applications, Math. Inequal. Appl. 19 (2016), 805–822.
- [15] J.-F. TIAN, ZH.-H. YANG, Generalizations of Hu-type inequalities and their applications, J. Nonlinear Sci. Appl. 10 (2017), 1971–1985.
- [16] P. M. VASIĆ, J. E. PEČARIĆ, On the Jensen inequality for monotone functions, An Univ Timişoara Ser Şt Matematice 17 (1979), 95–104.
- [17] C. L. WANG, Characteristics of nonlinear positive functionals and their applications, J. Math. Anal. Appl. 95 (1983), 564–574.
- [18] L. M. Wu, J. Sun, X. YE, L. Zhu, Hölder type inequality for Sugeno integral, Fuzzy Set. Syst. 161 (2010), 2337–2347.



- [19] ZH.-H. YANG, J. TIAN, Monotonicity and sharp inequalities related to gamma function, J. Math. Inequal. 12 (2018), 1–22.
- [20] ZH.-H. YANG, J. TIAN, Monotonicity and inequalities for the gamma function, J. Inequal. Appl. (2017) 2017:317.
- [21] ZH.-H. YANG, J. TIAN, Optimal inequalities involving power-exponential mean, arithmetic mean and geometric mean, J. Math. Inequal. 11 (2017), 1169–1183.
- [22] C. ZHAO, W. CHEUNG, *Hölder's reverse inequality and its applications*, Publications de L'institut Mathematique **99** (2016), 211–216.
- [23] C. ZHAO, W. CHEUNG, On reverse Minkowski-type inequalities, Mediterr. J. Math. 12 (2015), 1085– 1094.