WEIGHTED HARDY–TYPE INEQUALITIES FOR MONOTONE CONVEX FUNCTIONS WITH SOME APPLICATIONS

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Abstract. In this paper, we establish some new refined weighted Hardy-type inequalities involving monotone convex functions. We give the results for some special kernels of Riemann-Liouville and Weyl's operators as applications. Also we discuss some related dual cases. At the end, we prove some refined G. H. Hardy-type inequalities for different kinds of fractional integrals and fractional derivatives.

REFERENCES

[1] G. A. ANASTASSIOU, *Fractional Differentiation Inequalities*, Springer Science-Businness Media, LLC, Dordrecht, the Netherlands, 2009.

[2] M. ANDRIĆ, J. PEČARIĆ, I. PERIĆ, *A multiple Opial type inequality for the Riemann-Liouville fractional derivatives*, J. Math. Inequal. **7**, 1 (2013), 139–150.

[3] M. ANDRIĆ, J. PEČARIĆ, I. PERIĆ, *Improvements of composition rule for Canavati fractional derivative and applications to Opial-type inequalities*, Dynam. Systems Appl. **20** (2011), 383–394.

[4] M. ANDRIĆ, J. PEČARIĆ, I. PERIĆ, *Composition identities for the Caputo fractional derivatives and applications to Opial-type inequalities*, Math. Inequal. Appl. (2011), to appear.

[5] D. BALEANU, K. DIETHELM, E. SCALAS, J. J. TRUJILLO, *Fractional Calculus Models and Numerical Methods. Series on Complexity, Nonlinearity and Chaos*, Boston: World Scientific, 2012.

[6] D. BALEANU, O. G. MUSTAFA, R. P. AGARWAL, *Asymptotically Linear Solutions for Some Linear Fractional Differential Equations*, Abstr. Appl. Anal., Vol. **(2010)**, Article ID 865139, 8 pages.

[7] A. ČIŽMEŠIJA, K. KRULIĆ, J. PEČARIĆ, *Some new refined Hardy-type inequalities with kernels*, J. Math. Inequal. **4**, 4 (2010), 481–503.

[8] A. ČIŽMEŠIJA, K. KRULIĆ, J. PEČARIĆ, *A new class of general refined Hardy type inequalities with kernels*, Rad HAZU, (2013), to appear.

[9] N. ELEZOVIĆ, K. KRULIĆ, J. PEČARIĆ, *Bounds for Hardy type differences*, Acta Math. Sinica (Eng. Ser.) **27**, 4 (2011), 671–684.

[10] G. H. HARDY, *Notes on some points in the integral calculus*, Messenger. Math. **47**, 10 (1918), 145–150.

[11] S. IQBAL, K. KRULIĆ, J. PEČARIĆ, *On an inequality of H. G. Hardy*, Journal of Inequalities and Applications **2010** (2010), Artical ID 264347.

[12] S. KAIJSER, L. NIKOLOVA, L.-E. PERSSON, AND A. WEDESTIG, *Hardy type inequalities via convexity*, Math. Inequal. Appl. **8**, 3 (2005), 403–417.

[13] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and Application of Fractinal Differential Equations*, North-Holland Mathematics Studies, 204, Elsevier, New York-London, 2006.

[14] K. KRULIĆ, J. PEČARIĆ, L. E. PERSSON, *Some new Hardy type inequalities with general kernels*, Math. Inequal. Appl. **12** (2009), 473–485.

[15] K. B. OLDHAM, AND J. SPANIER, *The Fractional Calculus*, Academic Press, New York, 1974.

[16] J. PEČARIĆ, F. PROSCHAN, Y. L. TONG, *Convex Functions, Partial Orderings and Statistical Applications*, Academic Press, Inc. 1992.

[17] I. PODLUBNY, *Fractional Differential Equations*, Academic Press, San Diego, 1999.

[18] S. G. Samko, A. A. Kilbas and O. J. Marichev, *Fractional Integral and Derivatives: Theory and Applications*, Gordon and Breach Science Publishers, Switzerland, 1993.

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