

OPIAL-TYPE INEQUALITIES FOR FRACTIONAL INTEGRAL OPERATOR INVOLVING MITTAG—LEFFLER FUNCTION

GHULAM FARID, JOSIP PEČARIĆ AND ZIVORAD TOMOVSKI

Abstract. In this paper we give generalization of Opial-type inequalities by using generalized fractional integral operator involving generalized Mittag–Leffler function. We deduce some results which already have been proved. Also we consider n -exponential convexity of some non-negative differences of inequalities involving Mittag–Leffler function and deduce their exponential convexity and log-convexity.

Mathematics subject classification (2010): 26A33, 26D15, 33E12.

Keywords and phrases: Opial-type inequality, fractional integral, fractional derivative, Mittag–Leffler function.

REFERENCES

- [1] R. P. AGARWAL AND P. Y. H. PANG, *Opial Inequalities with Applications in Differential and Difference Equations*, Kluwer Academic Publishers, Dordrecht, Boston, London 1995.
- [2] G. A. ANASTASSIOU, *Advanced inequalities*, **11**, World Scientific, 2011.
- [3] M. ANDRIĆ, A. BARBIR, G. FARID AND J. PEČARIĆ, *More on certain Opial-type inequality for fractional derivatives*, *Nonlinear Functional Analysis and Applications*, **19**, No. 4 (2014), 565–583.
- [4] M. ANDRIĆ, A. BARBIR, G. FARID AND J. PEČARIĆ, *Opial-type inequality due to Agarwal–Pang and fractional differential inequalities*, *Integral Transforms and Special Functions*, **25**, No. 4 (2014).
- [5] M. ANDRIĆ, A. BARBIR, S. IQBAL, AND J. PEČARIĆ, *An Opial-type inequality and exponentially convex functions*, to appear.
- [6] M. ANDRIĆ, J. PEČARIĆ AND I. PERIĆ, *Improvements of composition rule for the Canavati fractional derivatives and applications to Opial-type inequalities*, *Dynam. Systems. Appl.*, **20** (2011), 383–394.
- [7] M. ANWAR, J. JAKŠETIĆ, J. PEČARIĆ AND ATIQ UR REHMAN, *Exponential convexity, positive semi-definite matrices and fundamental inequalities*, *J. Math. Inequal.*, **4** (2) (2010), 171–189.
- [8] L. CURIEL, L. GALUÉ, *A generalization of the integral operators involving the Gauss hypergeometric function*, *Revista Técnica de la Facultad de Ingeniería Universidad del Zulia*, **19** (1) (1996), 17–22.
- [9] G. FARID AND J. PEČARIĆ, *Opial type integral inequalities for fractional derivatives*, *Fractional Differential Calculus*, **2**, No. 1 (2012), 31–54.
- [10] G. FARID AND J. PEČARIĆ, *Opial type integral inequalities for fractional derivatives II*, *Fractional Differential Calculus*, **2**, No. 2 (2012), 139–155.
- [11] G. FARID AND PEČARIĆ, *Opial type integral Inequalities for Widder derivatives and linear differential operators*, *Int. J. Analysis Appl.*, *Int. J. Ana. App.*, Vol. **7**, No. 1 (2015), 38–49.
- [12] R. GARRA, R. GORENFLO, F. POLITO, Z. TOMOVSKI, *Hilfer-Prabhakar Derivatives and Some Applications*, *Applied Mathematics and Computation*, Vol. **242**, 576–589, 2014.
- [13] J. JAKŠETIĆ AND J. PEČARIĆ, *Exponential Convexity Method*, *J. Convex Anal.*, **20** (1) (2013), 181–197.
- [14] A. A. KILBAS, M. SAIGO, R. K. SAXENA, *Generalized Mittag–Leffler function and generalized fractional calculus operators*, *Integral Transform. Spec. Funct.* **15** (2004) 31–49.
- [15] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and Applications of fractional derivatival Equations*, *North-Holland Mathematics Studies*, 204, Elsevier, New York-London, 2006.
- [16] K. MILLER AND B. ROSS, *An introduction to the fractional calculus and fractional differential Equations*, John Wiley and Sons Inc., New York, 1993.

- [17] D. S. MITRINOVIĆ AND J. E. PEČARIĆ, *Generalizations of two inequalities of Godunova and Levin*, Bull. Polish Acad. Sci. Math., **36** (1988), 645–648.
- [18] K. OLDHAM AND J. SPANIER, *The fractional calculus*, Academic Press, New York-London, 1974.
- [19] J. PEČARIĆ AND J. PERIĆ, *Improvements of the Giaccardi and Petrović inequality and related Stolarsky type means*, An. Univ. Craiova Ser. Mat. Inform., **39** (1) (2012), 65–75.
- [20] J. E. PEČARIĆ, F. PROSCHAN AND Y. L. TONG, *Convex Functions, Partial Orderings and Statistical Applications*, Academic Press, Inc. (1992).
- [21] T. O. SALIM, AND A. W. FARAJ, *A Generalization of Mittag–Leffler function and integral operator associated with fractional calculus*, J. Fract. Calc. Appl. Vol. 3. July 2012, No. 5, pp. 1–13.
- [22] H. M. SRIVASTAVA, AND Ž. TOMOVSKI, *Fractional calculus with an integral operator containing generalized Mittag–Leffler function in the kernel*, Appl. Math. Comput. (2009), doi:10.1016/j.amc.2009.01.055.
- [23] Z. OPIAL, *Sur une inégalité*, Ann. Polon. Math., **8** (1960), 29–32.
- [24] J. PEČARIĆ, FRANK PROSCHAN, Y. L. TONG, *Convex Functions, Partial Orderings, and Statistical Applications*, Academic Press, Inc., 1992.
- [25] T. R. PRABHAKAR, *A singular integral equation with a generalized Mittag–Leffler function in the kernel*, Yokohama Math. J. **19** (1971) 7–15.
- [26] D. V. WIDDER, *The Laplace transform*, Princeton Uni. Press, New Jersey, 1941.