

INTEGRAL INEQUALITIES WITHIN THE FRAMEWORK OF GENERALIZED FRACTIONAL INTEGRALS

PAULO M. GUZMÁN, JUAN E. NÁPOLES VALDÉS* AND YUSIF S. GASIMOV

Abstract. In this work, a new generalized fractional integral is defined and studied, and different relationships (equalities and inequalities) are obtained, which have as particular cases several of those reported in the literature. Hermite-Hadamard type inequalities are obtained for different kinds of functions such as symmetric, convex symmetric, Wright-quasi-convex and h -symmetrized convex.

Mathematics subject classification (2020): 26D15, 26A51, 32F99, 41A17.

Keywords and phrases: Symmetrized convex function, Hermite-Hadamard type inequality.

REFERENCES

- [1] B. AHMAD, A. ALSAEDI, M. KIRANE AND B. T. TOBEREK, *Hermite-Hadamard, Hermite-Hadamard-Fejér, Dragomir-Agarwal and Pachpatte Type inequalities for convex functions via new integrals*, ArXiv: 1701.00092.
- [2] S. BERMUDO, P. KÓRUS AND J. E. NÁPOLES V., *On q -Hermite-Hadamard inequalities for general convex functions*, Acta Math. Hungar. (2020), <https://doi.org/10.1007/s10474-020-01025-6>.
- [3] S. S. DRAGOMIR, *Symmetrized convexity and Hermite-Hadamard type inequalities*, J. Math. Ineq. 10 (4) (2016) 901–918.
- [4] S. S. DRAGOMIR AND C. E. M. PEARCE, *Selected Topics on Hermite-Hadamard Inequalities and Applications*, RGMIA Monographs, Victoria University, Melbourne (2000).
- [5] A. EL FARSSI, M. BENBACHIR AND M. DAHMANE, *An extension of the Hermite-Hadamard inequality for convex symmetrized functions*, Real Analysis Exchange 38 (2) (2012) 467–474.
- [6] L. FEJÉR, *Über die Fourierreihen*, Math. Naturwise. Anz Ungar. Akad., Wiss 24 (1906) 369–390 (in Hungarian).
- [7] J. GALEANO DELGADO, J. E. NÁPOLES VALDÉS AND E. PÉREZ REYES, *A note on some integral inequalities in a generalized framework*, Int. J. Appl. Math. Stat., Vol. 60, Issue No. 1, Year 2021, 45–52.
- [8] J. GALEANO DELGADO, L. E. NÁPOLES VALDÉS AND E. PÉREZ REYES, *Several integral inequalities for generalized Riemann-Liouville fractional operators*, Commun. Fac. Sci. Univ. Ank. Ser. A1 Math. Stat. Volume 70, Number 1, 269–278 (2021), doi:10.31801/cfuasmas.771172.
- [9] J. GALEANO DELGADO, J.E. NÁPOLES VALDÉS, E. PÉREZ REYES AND M. VIVAS-CORTEZ, *The Minkowski Inequality for Generalized Fractional Integrals*, Appl. Math. Inf. Sci. 15, No. 1, 1–7 (2021), <http://dx.doi.org/10.18576/amis/150101>.
- [10] Y. S. GASIMOV, *An inverse spectral problem W. R. T. domain*, Mathematical Physics, Analysis, Geometry, Vol. 4, No. 3, 2008, pp. 358–370.
- [11] Y. S. GASIMOV AND N. A. ALLAHVERDIYEEVA, *Shape optimization for the eigenfrequency of the plate*, Georgian Mathematical Journal, 25 (1), 2018, pp. 19–24.
- [12] Y. S. GASIMOV, A. NACHAOUI AND A. A. NIIFTIYEV, *Nonlinear eigenvalue problems for p -Laplacian*, Optimization Letters, No. 4, 2010, pp. 67–84.
- [13] P. M. GUZMÁN AND J. E. NÁPOLES VALDÉS, *Generalized fractional Grüss-type inequalities*, Contrib. Math. 2 (2020) 16–21, doi:10.47443/cm.2020.0029.

- [14] J. HADAMARD, *Étude sur les propriétés des fonctions entières et en particulier d'une fonction considérée par Riemann*, J. Math. Pures Appl. 58, 171–215 (1893).
- [15] P. R. HALMOS, *Measure Theory*, D. Van Nostrand Company, Inc., New York, N. Y., 1950.
- [16] C. HERMITE, *Sur deux limites d'une intégrale définie*, Mathesis 3, 82 (1883).
- [17] I. ISCAN, *Hermite-Hadamard-Féjér type inequalities for convex functions via fractional integrals*, Stud. Univ. Babe-Bolyai Math. 60 (3) (2015) 355–366.
- [18] F. JARAD, E. UGURLU, T. ABDELJAWAD AND D. BALEANU, *On a new class of fractional operators*, Advances in Difference Equations (2017) 2017: 247, <https://doi.org/10.1186/s13662-017-1306-z>.
- [19] U. N. KATUGAMPOLA, *New Approach Generalized Fractional Integral*, Applied Math and Comp. 218 (2011), 860–865.
- [20] M. S. MITRINOVIC AND I. B. LACKOVIC, *Hermite and convexity*, Aequationes Math. 28 (1985) 229–232.
- [21] P. O. MOHAMMED, *Inequalities of $(k;s)$, $(k;h)$ -type for Riemann-Liouville Fractional Integrals*, Applied Mathematics E-Notes, 17 (2017), 199–206.
- [22] S. MUBEEN AND G. M. HABIBULLAH, *k -fractional integrals and applications*, Int. J. Contemp. Math. Sci. 7, 89–94 (2012).
- [23] J. E. NÁPOLES VALDÉS, F. RABOSSI AND A. D. SAMANIEGO, *Convex functions: Ariadne's thread or Charlotte's spiderweb?*, Advanced Mathematical Models & Applications Vol. 5, No. 2, 2020, pp. 176–191.
- [24] J. E. NÁPOLES, J. M. RODRÍGUEZ AND J. M. SIGARRETA, *New Hermite-Hadamard Type Inequalities Involving Non-Conformable Integral Operators*, Symmetry 2019, 11, 1108; doi:10.3390/sym11091108.
- [25] F. QI AND B. N. GUO, *Integral representations and complete monotonicity of remainders of the Binet and Stirling formulas for the gamma function*, Rev. R. Acad. Cienc. Exactas Fís. Nat., Ser. A Mat. 111 (2), 425–434 (2017), <https://doi.org/10.1007/s13398-016-0302-6>.
- [26] M. A. NOOR, K. I. NOOR AND S.IFTIKHAR, *Integral inequalities for extended harmonic convex functions*, Advanced Mathematical Models & Applications, Vol. 2, No. 3, 2017, pp. 215–228.
- [27] E. D. RAINVILLE, *Special Functions*, Macmillan Co., New York (1960).
- [28] R. T. ROCKAFELLAR, *Lagrange Multipliers and Optimality*, SIAM Review, Vol. 35, No. 2 (Jun., 1993), pp. 183–238.
- [29] M. Z. SARIKAYA, Z. DAHMANI, M. E. KIRIS AND F. AHMAD, *(k,s) -Riemann-Liouville fractional integral and applications*, Hacettepe Journal of Mathematics and Statistics Volume 45 (1) (2016), 77–89.
- [30] E. SET, A. O. AKDEMİR AND E. A. ALAN, *Some new conformable fractional integral inequalities for symmetrized convex functions*, Preprint.
- [31] E. SET, A. GOZPINAR AND E. A. ALAN, *Generalized fractional integral inequalities for some classes of symmetrized convex functions*, AIP Conf. Proc. 1991 (2018) 020010.
- [32] S. VAROSANEC, *On h -convexity*, J. Math. Anal. Appl., 326 (2007), 303–311.
- [33] Z. H. YANG AND J. F. TIAN, *Monotonicity and inequalities for the gamma function*, J. Inequal. Appl. 2017, 317 (2017), <https://doi.org/10.1186/s13660-017-1591-9>.
- [34] Z. H. YANG AND J. F. TIAN, *Monotonicity and sharp inequalities related to gamma function*, J. Math. Inequal. 12 (1), 1–22 (2018), <https://doi.org/10.7153/jmi-2018-12-01>.