

INEQUALITIES OF JENSEN'S TYPE FOR GENERALIZED k - g -FRACTIONAL INTEGRALS OF FUNCTION f FOR WHICH THE COMPOSITE $f \circ g^{-1}$ IS CONVEX

SILVESTRU SEVER DRAGOMIR

Abstract. In this paper we establish some inequalities of Jensen and Hermite-Hadamard type for the k - g -fractional integrals of function f for which the composite function $f \circ g^{-1}$ is convex. Some examples for the *generalized left- and right-sided Riemann-Liouville fractional integrals* of a function f with respect to another function g on $[a, b]$ are also given. Applications for Hadamard fractional integrals are provided as well.

Mathematics subject classification (2010): 26D15, 26D10, 26D07, 26A33.

Keywords and phrases: Generalized Riemann-Liouville fractional integrals, Hadamard fractional integrals, convex functions, Jensen's type inequalities, Hermite-Hadamard type inequalities.

REFERENCES

- [1] R. P. AGARWAL, M.-J. LUO AND R. K. RAINA, *On Ostrowski type inequalities*, Fasc. Math. **56** (2016), 5–27.
- [2] A. AGLIĆ ALJINOVIĆ, *Montgomery identity and Ostrowski type inequalities for Riemann-Liouville fractional integral*, J. Math. **2014**, Art. ID 503195, 6 pp.
- [3] T. M. APOSTOL, *Mathematical Analysis*, Second Edition, Addison-Wesley Publishing Company, 1975.
- [4] A. O. AKDEMIR, *Inequalities of Ostrowski's type for m - and (α, m) -logarithmically convex functions via Riemann-Liouville fractional integrals*, J. Comput. Anal. Appl. **16** (2014), no. 2, 375–383.
- [5] G. A. ANASTASSIOU, *Fractional representation formulae under initial conditions and fractional Ostrowski type inequalities*, Demonstr. Math. **48** (2015), no. 3, 357–378.
- [6] G. A. ANASTASSIOU, *The reduction method in fractional calculus and fractional Ostrowski type inequalities*, Indian J. Math. **56** (2014), no. 3, 333–357.
- [7] G. D. ANDERSON, M. K. VAMANAMURTHY AND M. VUORINEN, *Generalized convexity and inequalities*, J. Math. Anal. Appl. **335** (2007) 1294–1308.
- [8] H. BUDAK, M. Z. SARIKAYA, E. SET, *Generalized Ostrowski type inequalities for functions whose local fractional derivatives are generalized s -convex in the second sense*, J. Appl. Math. Comput. Mech. **15** (2016), no. 4, 11–21.
- [9] P. CERONE AND S. S. DRAGOMIR, *Midpoint-type rules from an inequalities point of view*, Handbook of analytic-computational methods in applied mathematics, 135–200, Chapman & Hall/CRC, Boca Raton, FL, 2000.
- [10] S. S. DRAGOMIR, *The Ostrowski's integral inequality for Lipschitzian mappings and applications*, Comput. Math. Appl. **38** (1999), no. 11–12, 33–37.
- [11] S. S. DRAGOMIR, *The Ostrowski integral inequality for mappings of bounded variation*, Bull. Austral. Math. Soc. **60** (1999), no. 3, 495–508.
- [12] S. S. DRAGOMIR, *On the midpoint quadrature formula for mappings with bounded variation and applications*, Kragujevac J. Math. **22** (2000), 13–19.
- [13] S. S. DRAGOMIR, *On the Ostrowski's integral inequality for mappings with bounded variation and applications*, Math. Ineq. Appl. **4** (2001), no. 1, 59–66, preprint: RGMIA Res. Rep. Coll. **2** (1999), Art. 7, online <http://rgmia.org/papers/v2n1/v2n1-7.pdf>.

- [14] S. S. DRAGOMIR, *Refinements of the generalised trapezoid and Ostrowski inequalities for functions of bounded variation*, Arch. Math. (Basel) **91** (2008), no. 5, 450–460.
- [15] S. S. DRAGOMIR, *Refinements of the Ostrowski inequality in terms of the cumulative variation and applications*, Analysis (Berlin) **34** (2014), no. 2, 223–240, preprint: RGMIA Res. Rep. Coll. **16** (2013), Art. 29, online <http://rgmia.org/papers/v16/v16a29.pdf>.
- [16] S. S. DRAGOMIR, *Inequalities of Hermite-Hadamard type for GA-convex functions*, RGMIA Res. Rep. Coll. **18** (2015), Art. 30, online <http://rgmia.org/papers/v18/v18a30.pdf>.
- [17] S. S. DRAGOMIR, *Some new inequalities of Hermite-Hadamard type for GA-convex functions*, RGMIA Res. Rep. Coll. **18** (2015), Art. 33, online <http://rgmia.org/papers/v18/v18a33.pdf>.
- [18] S. S. DRAGOMIR, *Inequalities of Jensen type for GA-convex functions*, RGMIA Res. Rep. Coll. **18** (2015), Art. 35, online <http://rgmia.org/papers/v18/v18a35.pdf>.
- [19] S. S. DRAGOMIR, *Ostrowski type inequalities for Lebesgue integral: a survey of recent results*, Australian J. Math. Anal. Appl., vol. **14**, issue 1, Art. 1, pp. 1–287, 2017, online <http://ajmaa.org/cgi-bin/paper.pl?string=v14n1/V14I1P1.tex>.
- [20] S. S. DRAGOMIR, *Some inequalities of Hermite-Hadamard type for convex functions and Riemann-Liouville fractional integrals*, preprint RGMIA Res. Rep. Coll. **20** (2017), Art. 40, online <http://rgmia.org/papers/v20/v20a40.pdf>.
- [21] S. S. DRAGOMIR, *Ostrowski type inequalities for Riemann-Liouville fractional integrals of bounded variation, Hölder and Lipschitzian functions*, preprint RGMIA Res. Rep. Coll. **20** (2017), Art. 48, online <http://rgmia.org/papers/v20/v20a48.pdf>.
- [22] S. S. DRAGOMIR, *Ostrowski type inequalities for generalized Riemann-Liouville fractional integrals of functions with bounded variation*, RGMIA Res. Rep. Coll. **20** (2017), Art. 58, online <http://rgmia.org/papers/v20/v20a58.pdf>.
- [23] S. S. DRAGOMIR, *Further Ostrowski and trapezoid type inequalities for the generalized Riemann-Liouville fractional integrals of functions with bounded variation*, RGMIA Res. Rep. Coll. **20** (2017), Art. 84, online <http://rgmia.org/papers/v20/v20a84.pdf>.
- [24] S. S. DRAGOMIR, *Ostrowski and trapezoid type inequalities for the generalized k - g -fractional integrals of functions with bounded variation*, RGMIA Res. Rep. Coll. **20** (2017), Art. 111, online <http://rgmia.org/papers/v20/v20a111.pdf>.
- [25] S. S. DRAGOMIR, *Some inequalities for the generalized k - g -fractional integrals of functions under complex boundedness conditions*, RGMIA Res. Rep. Coll. **20** (2017), Art. 119, online <http://rgmia.org/papers/v20/v20a119.pdf>.
- [26] S. S. DRAGOMIR, *Inequalities of Jensen's type for generalized k - g -fractional integrals*, RGMIA Res. Rep. Coll. **20** (2017).
- [27] S. S. DRAGOMIR AND C. E. M. PEARCE, *Selected Topics on Hermite-Hadamard Inequalities and Applications*, RGMIA Monographs, 2000, online http://rgmia.org/monographs/hermite_hadamard.html.
- [28] A. GUEZANE-LAKOUD AND F. AISSAOUI, *New fractional inequalities of Ostrowski type*, Transylv. J. Math. Mech. **5** (2013), no. 2, 103–106.
- [29] A. KASHURI AND R. LIKO, *Ostrowski type fractional integral inequalities for generalized (s, m, φ) -preinvex functions*, Aust. J. Math. Anal. Appl. **13** (2016), no. 1, Art. 16, 11 pp.
- [30] A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, 204. Elsevier Science B. V., Amsterdam, 2006.
- [31] M. KIRANE, B. T. TOREBEK, *Hermite-Hadamard, Hermite-Hadamard-Fejer, Dragomir-Agarwal and Pachpatte type Inequalities for convex functions via fractional integrals*, preprint arXiv:1701.00092.
- [32] M. A. NOOR, K. I. NOOR AND S. IFTIKHAR, *Fractional Ostrowski inequalities for harmonic h -preinvex functions*, Facta Univ. Ser. Math. Inform. **31** (2016), no. 2, 417–445.
- [33] R. K. RAINA, *On generalized Wright's hypergeometric functions and fractional calculus operators*, East Asian Math. J., **21** (2) (2005), 191–203.
- [34] M. Z. SARIKAYA AND H. FILIZ, *Note on the Ostrowski type inequalities for fractional integrals*, Vietnam J. Math. **42** (2014), no. 2, 187–190.
- [35] M. Z. SARIKAYA AND H. BUDAK, *Generalized Ostrowski type inequalities for local fractional integrals*, Proc. Amer. Math. Soc. **145** (2017), no. 4, 1527–1538.

- [36] E. SET, *New inequalities of Ostrowski type for mappings whose derivatives are s -convex in the second sense via fractional integrals*, *Comput. Math. Appl.* **63** (2012), no. 7, 1147–1154.
- [37] M. TUNÇ, *On new inequalities for h -convex functions via Riemann-Liouville fractional integration*, *Filomat* **27**: 4 (2013), 559–565.
- [38] M. TUNÇ, *Ostrowski type inequalities for m - and (α, m) -geometrically convex functions via Riemann-Liouville fractional integrals*, *Afr. Mat.* **27** (2016), no. 5–6, 841–850.
- [39] H. YILDIRIM AND Z. KIRTAY, *Ostrowski inequality for generalized fractional integral and related inequalities*, *Malaya J. Mat.*, **2** (3) (2014), 322–329.
- [40] C. YILDIZ, E. ÖZDEMİR AND Z. S. MUHAMET, *New generalizations of Ostrowski-like type inequalities for fractional integrals*, *Kyungpook Math. J.* **56** (2016), no. 1, 161–172.
- [41] H. YUE, *Ostrowski inequality for fractional integrals and related fractional inequalities*, *Transylv. J. Math. Mech.* **5** (2013), no. 1, 85–89.
- [42] X.-M. ZHANG, Y.-M. CHU AND X.-H. ZHANG, *The Hermite-Hadamard type inequality of GA-convex functions and its application*, *Journal of Inequalities and Applications*, vol. **2010**, Article ID 507560, 11 pages.