

COORDINATE STRONGLY s -CONVEX FUNCTIONS AND RELATED RESULTS

SYED ZAHEER ULLAH, MUHAMMAD ADIL KHAN, ZAREEN A. KHAN AND
YU-MING CHU

Abstract. In this article, we give non-trivial examples of coordinate s -convex functions which are not s -convex functions. Also, we present a new class of coordinate strongly s -convex functions. We prove that every strongly s -convex function is coordinate strongly s -convex function but the converse is not generally true. Furthermore, we establish Jensen type inequality for strongly s -convex functions. We present Jensen and Hermite-Hadamard type inequalities for coordinate strongly s -convex functions.

Mathematics subject classification (2010): 26A51, 26D15.

Keywords and phrases: s -convex function, strongly convex function, strongly s -convex function.

REFERENCES

- [1] S. ABRAMOVICH, *Convexity, subadditivity and generalized Jensen's inequality*, Ann. Funct. Anal. **4** (2013), 183–194.
- [2] G. A. ANASTASSIOU, *Basic and s -convexity Ostrowski and Grüss type inequalities involving several functions*, Commun. Appl. Anal. **17** (2013), 189–212.
- [3] M. ADIL KHAN, T. ALI, A. KILIÇMAN AND Q. DIN, *Refinements of Jensen's inequality for convex functions on the co-ordinates in a rectangle from the plane*, Filomat. **3**(30) (2016), 803–814.
- [4] M. ADIL KHAN, S. ZAHEER ULLAH, AND Y.-M. CHU, *The concept of coordinate strongly convex functions and related inequalities*, Rev. R. Acad. Cienc. Exactas Fís. Nat. Ser. A Mat. RACSAM, **113** (2019), 2235–2251.
- [5] M. ALOMARI AND M. DARUS, *The Hadamard's inequality for s -convex function of 2-variables on the co-ordinates*, Int. Journal of Math. Analysis. **2**(13) (2008), 629–638.
- [6] M. KLARIČIĆ BAKULA AND J. PEČARIĆ, *On the Jensen's inequality for convex functions on the co-ordinates in a rectangle from the plane*, Taiwanese J. Math. **10** (2006), 1271–1292.
- [7] X. CHEN, *New convex functions in linear spaces and Jensen's discrete inequality*, J. Inequal. Appl. **1** (2013), 472–485.
- [8] Y.-M. CHU, G.-D. WANG AND X.-H. ZHANG, *Schur convexity and Hadamard's inequality*, Math. Inequal. Appl. **13**(4) (2010), 725–731.
- [9] Y.-M. CHU, G.-D. WANG AND X.-H. ZHANG, *The Schur multiplicative and harmonic convexities of the complete symmetric function*, Math. Nachr. **284**(5-6) (2011), 653–663.
- [10] B. DEFINETTI, *Sulla stratificazioni convesse*, Ann. Math. Pura. Appl. **30** (1949), 173–183.
- [11] S. S. DRAGOMIR, *On the Hadamard's inequality for convex functions on the co-ordinates in a rectangle from the plane*, Taiwanese J. Math. **5** (2001), 775–778.
- [12] S. S. DRAGOMIR, *Inequalities of Hermite-Hadamard type for ϕ -convex functions*, Preprint RGMIA Res. Rep. Coll. 16, **14** (2013), Art. 87, Online <http://rgmia.org/papers/v16/v16a87.pdf>.
- [13] S. S. DRAGOMIR, *Inequalities of Hermite-Hadamard type for λ -convex functions on linear spaces*, Preprint RGMIA Res. Rep. Coll. 17, **18** (2014) Art. 13, Online <http://rgmia.org/papers/v17/v17a13.pdf>.
- [14] S. S. DRAGOMIR AND S. FITZPATRICK, *The Jensen inequality for s -breckner convex functions in linear spaces*, Demonstratio Math. **XXXIII** (2000), 8 pages.

- [15] JÜ HUA, BO-YAN XI AND FENG QI, *Some new inequalities of Simpson type for strongly s -convex functions*, Afr. Mat. **26** (2015), 741–752.
- [16] D. H. HYERS AND S. M. ULAM, *Approximately convex functions*, Proc. Amer. Math. Soc. **3** (1952), 821–828.
- [17] J. L. W. V. JENSEN, *On konvexe funktioner og uligheder mellem middlvaerdier*, Nyt. Tidsskr. Math. B. **16** (1905), 49–69.
- [18] Y. KHURSHID, M. ADIL KHAN, Y.-M. CHU, Z. A. KHAN AND L.-S. LIU, *Hermite-Hadamard-Fejér inequalities for conformable fractional integrals via preinvex functions*, J. Funct. Spaces. **2019** (2019), Article ID 3146210, 9 pages.
- [19] O. L. MANGASARIAN, *Pseudo-Convex functions*, SIAM. Journal on Control. **3** (1965), 281–290.
- [20] F.-C. MITROI-SYMEONIDIS AND N. MINCULETE, *On the Jensen functional and strong convexity*, Bull. Malays. Math. Sci. Soc. **41**(1) (2018), 311–319.
- [21] N. MERENTES AND K. NIKODEM, *Remarks on strongly convex functions*, Aequ. Math. **80** (2010), 193–199.
- [22] H. R. MORADI, M. E. OMIÐVAR, M. ADIL KHAN AND K. NIKODEM, *Around Jensen's inequality for strongly convex functions*, Aequationes Math. **92**(1) (2018), 25–37.
- [23] W. ORLICZ, *A note on modular spaces, I*, Bull. Acad. Polon. Sci. Math. Astronom. Phys. **9** (1961), 157–162.
- [24] B. T. POLYAK, *Existence theorems and convergence of minimizing sequences in extremum problems with restrictions*, Sov. Math. Dokl. **7** (1966), 72–75.
- [25] J. PEČARIĆ, F. PROSCHAN AND Y. L. TONG, *Convex Functions, Partial Orderings, and Statistical Applications*, Academic Press, New York, 1992.
- [26] T. RAJBA, *On strong delta-convexity and Hermite-Hadamard type inequalities for delta-convex functions of higher order*, Math. Inequal. Appl. **18** (2015), 267–293.
- [27] A. W. ROBERTS AND D. E. VARBERG, *Convex functions*, Academic Press, New York, 1973.
- [28] I. SCHUR, *Über eine Klasse von Mittelbildungen mit Anwendungen auf die Determinantentheorie*, Sitzungsber. Berlin. Math. Ges. **22** (1923), 9–20.
- [29] Y.-Q. SONG, M. ADIL KHAN, S. ZAHEER ULLAH, AND Y.-M. CHU, *Integral inequalities involving strongly convex functions*, J. Funct. Spaces, **2018** (2018), Article ID 6596921, 8 pages.
- [30] E. SET, M. E. ÖZDEMİR AND S. S. DRAGOMIR, *On Hadamard-type inequalities involving several kinds of convexity*, J. Inequal. Appl. **12** (2010), Art. ID 286845, 12 pages.
- [31] S. VAROŠANEC, *On h -convexity*, J. Math. Anal. Appl. **326** (2007), 303–311.
- [32] S. ZAHEER ULLAH, M. ADIL KHAN AND Y.-M. CHU, *Majorization theorems for strongly convex functions*, J. Inequal. Appl. **2019** (2019), 13 pages.
- [33] S. ZAHEER ULLAH, M. ADIL KHAN, Z. A. KHAN AND Y.-M. CHU, *Integral majorization type inequalities for the functions in the sense of strong convexity*, J. Funct. Spaces, **2019** (2019), Article ID 9487823, 11 pages.
- [34] S. ZAHEER ULLAH, M. ADIL KHAN AND Y.-M. CHU, *A note on generalized convex functions*, J. Inequal. Appl. **2019** (2019), 10 pages.