

NEW QUANTUM INEQUALITIES OF HERMITE-HADAMARD
TYPE VIA GREEN FUNCTION

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Abstract. In this study, the Hermite-Hadamard inequality for q^{κ_2} -integrals is demonstrated by a new method called the Green Function Technique. For this purpose, we first obtain certain identities. Then, by using these identities, we establish many new inequalities for functions whose second derivative is convex, monotone and concave in absolute value.

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REFERENCES

- [1] M. Adil Khan, N. Mohammad, E. R. Nwaeze and Y.-M. Chu, *Quantum Hermite-Hadamard inequality by means of a Green function*, Adv. Difference Equ., **2020** (2020), 1–20.
- [2] R. P. Agarwal and P. J. Y. Wong, *Error inequalities in polynomial interpolation and their applications*, Mathematics and its Applications (Dordrecht), Vol. 262, Kluwer Academic Publishers, Dordrecht, 1993.
- [3] N. Alp, M. Z. Sarikaya, M. Kunt and I. Işcan, *q -Hermite Hadamard inequalities and quantum estimates for midpoint type inequalities via convex and quasi-convex functions*, J. King Saud Univ. Sci., **30** (2018), 193–203.
- [4] S. Bermudo, P. Kórus and J. E. Nápoles Valdés, *On q -Hermite-Hadamard inequalities for general convex functions*, Acta Math. Hungar., **162** (2020), 364–374.
- [5] S. S. Dragomir, *Inequalities of Jensen's type for generalized k - g -fractional integrals*, Tamkang J. Math., **49** (2018), 247–266.
- [6] T. Ernst, *The history of q -calculus and a new method*, Licentiate Thesis, Uppsala University, Uppsala, 2001.
- [7] T. Ernst, *A comprehensive treatment of q -calculus*, Birkhäuser, Basel, 2012.
- [8] F. H. Jackson, *On q -definite integrals*, The Quarterly Journal of Pure and Applied Mathematics, **41** (1910), 193–203.
- [9] V. Kac and P. Cheung, *Quantum calculus*, Universitext, Springer, New York, NY, 2001.
- [10] W. Liu and H. Zhuang, *Some quantum estimates of Hermite-Hadamard inequalities for convex functions*, J. Appl. Anal. Comput., **7** (2017), 501–522.
- [11] N. Mehmood, R. P. Agarwal, S. I. Butt and J. Pečarić, *New generalizations of Popoviciu-type inequalities via new Green's functions and Montgomery identity*, J. Inequal. Appl., **108** (2017), 1–17.

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- [12] M. A. Noor, M. U. Awan and K. I. Noor, *Quantum Ostrowski inequalities for q -differentiable convex functions*, J. Math. Inequal., **10** (2016), 1013–1018.
- [13] M. A. Noor, K. I. Noor and M. U. Awan, *Some quantum estimates for Hermite-Hadamard inequalities*, Appl. Math. Comput., **251** (2015), 675–679.
- [14] M. A. Noor, K. I. Noor and M. U. Awan, *Some quantum integral inequalities via preinvex functions*, Appl. Math. Comput., **269** (2015), 242–251.
- [15] J. E. Pečarić, F. Proschan and Y. L. Tong, *Convex functions, partial orderings, and statistical applications*, Math. Sci. Eng., Vol. 187, Academic Press, Boston, 1992.
- [16] W. Sudsutad, S. K. Ntouyas and J. Tariboon, *Quantum integral inequalities for convex functions*, J. Math. Inequal., **9** (2015), 781–793.
- [17] J. Tariboon and S. K. Ntouyas, *Quantum calculus on finite intervals and applications to impulsive difference equations*, Adv. Difference Equ., **2013** (2013), 1–19.
- [18] T. Tunç, M. Z. Sarikaya and H. Yaldız, *Fractional Hermite Hadamard's type inequality for the co-ordinated convex functions*, TWMS J. Pure Appl. Math., **11** (2020), 3–29.
- [19] Y. Zhang, T.-S. Du, H. Wang and Y.-J. Shen, *Different types of quantum integral inequalities via (α, m) -convexity*, J. Inequal. Appl., **2018** (2018), 1–24.
- [20] H. Zhuang, W. Liu and J. Park, *Some quantum estimates of Hermite-Hadamard inequalities for quasi-convex functions*, Mathematics, **7** (2019), 1–18.

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