Journal of Mathematical Inequalities
Volume 15, Number 2 (2021), 547–558
doi:10.7153/jmi-2021-15-40

APPROXIMATION PROPERTIES OF MODIFIED KANTOROVICH TYPE (p,q)–BERNSTEIN OPERATORS

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Abstract. In the present paper, we construct modified Bernstein-Kantorovich operators by adding a parameter α and using new method and idea based on (p,q)-calculus. We establish the moments and the central moments of the operators. Then, we obtain a Korovkin type approximation theorem and discuss two local approximation theorems using Steklov mean and K-functional in terms of modulus of smoothness. Next, the rate of convergence on continuous function space, differentiable function space and Lipschitz function space are studied. Finally, Voronovskaja type theorem is also investigated.

Mathematics subject classification (2020): 41A36, 41A25, 41A10.
Keywords and phrases: modified (p,q)-Bernstein-Kantorovich operators, local approximation, modulus of smoothness, rate of convergence, Voronovskaja type theorem.

REFERENCES

[1] T. ACAR, A. ARAL, S. A. MOHIUDDINE, *On Kantorovich modification of (p,q)-Baskakov operators*, J. Inequal. Appl., **98** (2016).
[2] T. ACAR, A. ARAL, S. A. MOHIUDDINE, *On Kantorovich modification of (p,q)-Bernstein operators*, Iran. J. Sci. Technol. Trans. Sci., **42**, 3 (2018), 1459–1464.
[3] A. M. ACU, P. N. AGRAWAL, D. KUMAR, *Approximation properties of modified q-Bernstein-Kantorovich Operators*, Commun. Fac. Sci. Univ. Ank. Ser. A1 Math. Stat., **68**, 2 (2019), 2170–2197.
[4] A. ARAL, V. GUPTA, R. P. AGARWAL, *Application of q-Calculus in Operator Theory*, Springer, Berlin, (2013).
[5] R. A. DEVORE, G. G. LORENTZ, *Constructive Approximation*, Springer, Berlin, (1993).
[6] V. GUPTA, *(p,q)-Genuine Bernstein Durrmeyer operators*, Boll. Unione Mat. Ital., **9**, 3 (2016), 399–409.
[7] V. GUPTA, *(p,q)-Baskakov-Kantorovich Operators*, Appl. Math. Inf. Sci., **10**, 4 (2016), 1551–1556.
[8] V. GUPTA, R. P. AGARWAL, *Convergence Estimates in Approximation Theory*, Springer, New York, (2014).
[9] V. GUPTA, T. M. RASSIAS, P. N. AGRAWAL, A. M. ACU, *Recent Advances in Constructive Approximation Theory*, Springer, New York, (2018).
[10] G. G. LORENTZ, *Bernstein Polynomials*, Math. Expo. Vol. 8. Univ. of Toronto Press, Toronto, 1953.
[11] N. I. MAHMUDOV, P. SABANCIGIL, *Approximation Theorems for q-Bernstein-Kantorovich Operators*, Filomat, **27**, 4 (2013), 721–730.
[12] M. MURSALEEN, A. ALOTAIBI, ,K. J. ANSARI, *On a Kantorovich of (p,q)-Szász-Mirakjan operators*, J. Funct. Space., (2016) [Article ID 1035253].
[13] M. MURSALEEN, A. NAAZ, A. KHAN, *Improved approximation and error estimations by King type (p,q)-Szász-Mirakjan Kantorovich operators*, Appl. Math. Comput., **348**, (2019), 175–185.
[14] M. MURSALEEN, F. KHAN, A. KHAN, *On (p,q)-analogue of Bernstein operators*, Appl. Math. Comput., **266**, (2015), 874-882, Erratum: Appl. Math. Comput., **278**, (2016): 70–71.
[15] M. A. ÖZARSLAN, O. DUMAN, *Smoothness properties of modified Bernstein-Kantorovich operators*, Numer. Func. Anal. Opt., **37**, 1 (2016), 92–105.