

POINTWISE ESTIMATE FOR LINEAR COMBINATIONS OF PHILLIPS OPERATORS

GANCHO TACHEV

Abstract. For pointwise approximation of bounded continuous functions by linear combinations of Phillips operators we represent equivalent relation by means of Ditzian-Totik modulus of smoothness. The rate of approximation is better compared with similar estimates, proved in the past for other Szász-type operators.

Mathematics subject classification (2010): 41A10, 41A25, 41A36.

Keywords and phrases: Pointwise approximation, Ditzian-Totik modulus of smoothness, linear combinations, inverse theorems, Phillips operators.

REFERENCES

- [1] P. N. AGRAWAL AND V. GUPTA, *On the iterative combinations of Phillips operators*, Bull. Inst. Math. Acad. Sinica, **18**, 4 (1990), 361–368.
- [2] P. N. AGRAWAL AND V. GUPTA, *On convergence of derivatives of Phillips operators*, Demonstratio Mathematica, **27**, 2 (1994), 501–510.
- [3] P. N. AGRAWAL, V. GUPTA AND A. R. GAIROLA, *On derivatives of an iterative combinations of Phillips operators*, Nonlinear Functional Analysis and Applications, **12**, 2 (2007), 195–203.
- [4] J. BUSTAMANTE, J. QUESADA AND L. CRUZ, *Direct estimate for linear operators in polynomial weighted spaces*, J. Approx. Theory, **162** (2010), 1495–1508.
- [5] P. L. BUTZER, *Linear combinations of Bernstein polynomials*, Canad. J. Math., (1953), 559–567.
- [6] V. GUPTA AND P. N. AGRAWAL, *Linear Combinations of Phillips Operators*, Indian Acad. Math., **11**, 2 (1989), 106–114.
- [7] V. GUPTA AND P. N. AGRAWAL, *L_p-Approximation by iterative combination of Phillips operators*, Publ. de l’Institut Mathématique, **52** (66), (1992), 67–76.
- [8] V. GUPTA AND A. SAHAI, *On the linear combinations of Phillips operators*, Soochow Journal of Mathematics, **19**, 3 (1993), 313–323.
- [9] S. GUO, C. LI, Y. SUN, G. YANG AND S. YUE, *Pointwise Estimate for Szász-Type Operators*, J. Approx. Theory, **94** (1998), 160–171.
- [10] S. GUO, S. YUE, C. LI, G. YANG AND Y. SUN, *A pointwise approximation theorem for linear combinations of Bernstein polynomials*, Abstr. Appl. Anal., **1** (1996), 359–368.
- [11] S. GUO, C. LI AND X. LIU, *Pointwise Approximation for Linear Combinations of Bernstein Operators*, J. Approx. Theory, **107** (2000), 109–120.
- [12] S. GUO, L. LIU AND Q. QI, *Pointwise Estimate for Linear Combinations of Bernstein-Kantorovich Operators*, J. Math. Anal. Appl., **265** (2002), 135–147.
- [13] Z. DITZIAN, *A global inverse theorem for combinations of Bernstein polynomials*, J. Approx. Theory, **26** (1979), 277–292.
- [14] Z. DITZIAN AND V. TOTIK, *Moduli of Smoothness*, Springer Verlag, New York, (1987).
- [15] Z. DITZIAN AND K. IVANOV, *Strong converse inequalities*, J. Anal. Math., **61** (1993), 61–111.
- [16] M. HEILMANN, *Erhöhung der Konvergenzgeschwindigkeit bei der Approximation von Funktionen mit Hilfe von Linearkombinationen spezieller positiver linear Operatoren*, Habilitationsschrift, Universität Dortmund, (1991).
- [17] M. HEILMANN, *Approximation auf [0,∞) durch das Verfahren der Operatoren vom Baskakov-Durrmeyer Typ*, Dissertation, Universität Dortmund, (1987).

- [18] M. HEILMANN AND G. TACHEV, *Commutativity, direct and strong converse results for Phillips operators*, East Journal on Approximations, **17**, 3 (2011), 299–317.
- [19] MARGARETA HEILMANN AND GANCHO TACHEV, *Linear Combinations of Genuine Szász-Mirakjan – Durrmeyer Operators*, Springer Proceedings in Mathematics and Statistics with Volume title Advances in Applied Mathematics and Approximation Theory – Contributions from AMAT 2012 Conference, Turkey, ed. by G. Anastassiou and O. Duman, (2012), 5-th Chapter, 85–106.
- [20] C. P. MAY, *On Phillips Operator*, J. Approx. Theory, **20**, (1977), 315–322.
- [21] S. M. MAZHAR AND V. TOTIK, *Approximation by modified Szász operators*, Acta Scientiarum Mathematicarum, **49**, (1985), 257–269.
- [22] R. S. PHILLIPS, *An inversion formula for Laplace transforms and semi-groups of linear operators*, Annals Math. **59**, 2 (1954), 325–356.
- [23] GANCHO TACHEV, *Approximation of bounded continuous functions by linear combinations of Phillips operators*, Demonstratio Mathematica, **XLVII**, 3 (2014), 662–671.
- [24] GANCHO TACHEV, *A Global Inverse Theorem for Combinations of Phillips Operators*, accepted in Mediterranean Journal of Mathematics, (2015).
- [25] LINSEN XIE, *The lower estimate for the linear combinations of Bernstein-Kantorovich operators*, J. Approx. Theory, **162**, (2010), 1150–1159.
- [26] LINSEN XIE, *Pointwise simultaneous approximation by combinations of Bernstein operators*, J. Approx. Theory, **137**, (2005), 1–21.
- [27] LINSEN XIE, *Strong type of Stechkin inequality for the linear combination of Bernstein operators*, J. Math. Anal. Appl., **408**, (2013), 615–622.
- [28] D. X. ZHOU, *On a Paper of Mazhar and Totik*, J. Approx. Theory, **72**, (1993), 290–300.