DEGREE OF APPROXIMATION BY KANTOROVICH-SHILKRET QUASI-INTERPOLATION NEURAL NETWORK OPERATORS REVISITED

GEORGE A. ANASTASSIOU

ABSTRACT. In this article we exhibit multivariate basic approximation by a Kantorovich-Shilkret type quasi-interpolation neural network operators with respect to supremum norm. This is done with rates using the multivariate modulus of continuity. We approximate continuous and bounded functions on $\mathbb{R}^N$, $N \in \mathbb{N}$. When they are additionally uniformly continuous we derive pointwise and uniform convergences. We include also the related Complex approximation. Our activation functions are induced by the arctangent, algebraic, Gudermannian and generalized symmetrical sigmoid functions.

REFERENCES

[1] G.A. Anastassiou, *Intelligent Systems II: Complete Approximation by Neural Network Operators*, Springer, Heidelberg, New York, 2016.

[2] G.A. Anastassiou, *Intelligent Computations: Abstract Fractional Calculus, Inequalities, Approximations*, Springer, Heidelberg, New York, 2018.

[3] G.A. Anastassiou, *Ordinary and Fractional Approximation by Non-additive Integrals: Choquet, Shilkret and Sugeno Integral Approximators*, Springer, Heidelberg, New York, 2019.

[4] G.A. Anastassiou, *Algebraic function based Banach space valued ordinary and fractional neural network approximations*, New Trends in Mathematical Sciences, 10 special issues (1) (2022), 100-125.

[5] G.A. Anastassiou, *Gudermannian function activated Banach space valued ordinary and fractional neural network approximation*, Advances in Nonlinear Variational Inequalities, 25 (2) (2022), 27-64.

[6] G.A. Anastassiou, *Generalized symmetrical sigmoid function activated Banach space valued ordinary and fractional neural network approximation*, Analele Universităţii Oradea, Fasc. Matematica, accepted for publication, 2022.

[7] G.A. Anastassiou, *Abstract multivariate Gudermannian function activated neural network approximations*, Panamerican Mathematical Journal, accepted, 2022.

[8] G.A. Anastassiou, *General multivariate arctangent function activated neural network approximations*, submitted, 2022.

[9] G.A. Anastassiou, *Abstract multivariate algebraic function activated neural network approximations*, submitted, 2022.

[10] G.A. Anastassiou, *Generalized symmetrical sigmoid function activated neural network multivariate approximation*, submitted, 2022.

[11] A.J. Dunning, J. Kensler, L. Goudeville, F. Bailleux, *Some extensions in continuous methods for immunological correlates of protection*, BMC Medical Research Methodology 15 (107) (28 Dec. 2015), doi:10.1186/s12874-015-0096-9.

[12] I.S. Haykin, *Neural Networks: A Comprehensive Foundation* (2 ed.), Prentice Hall, New York, 1998.

[13] W. McCulloch and W. Pitts, *A logical calculus of the ideas immanent in nervous activity*, Bulletin of Mathematical Biophysics, 7 (1943), 115-133.

[14] T.M. Mitchell, *Machine Learning*, WCB-McGraw-Hill, New York, 1997.

[15] Niel Shilkret, *Maxitive measure and integration*, Indagationes Mathematicae, 33 (1971), 109-116.

[16] E.W. Weisstein, *Gudermannian*, MathWorld.

DEPARTMENT OF MATHEMATICAL SCIENCES, UNIVERSITY OF MEMPHIS, MEMPHIS, TN 38152, U.S.A.
Email address: ganastss@memphis.edu