

## ON SOME NEW NONLINEAR VOLTERRA–FREDHOLM TYPE DISCRETE INEQUALITIES AND ITS APPLICATIONS

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*Abstract.* In this paper, we develop some extensions and generalizations of some new nonlinear Volterra-Fredholm type discrete inequalities. These inequalities can be used as handy tools in the study of class of nonlinear Volterra-Fredholm sum-difference equations and its variants to obtain bound on the unknown function and analysis of various properties of solutions.

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### REFERENCES

- [1] PACHPATTE, B.G., *Inequalities for Finite Difference Equations*, Marcel Dekker, Inc., New York, (2002).
- [2] SALEM SH. AND RASLAN K.R., *Some New Discrete Inequalities and Their Applications*, Journal of Inequalities in Pure and Applied Mathematics, Vol 5, Issue 1, (2004).
- [3] QING-HUA MA, *Some New nonlinear Volterra-Fredholm-type discrete inequalities and their Applications*, Journal of Computational and Applied Mathematics, 216, (2008), (451–466).
- [4] QING-HUA MA AND WING-SUM CHEUNG, *Some New Nonlinear difference inequalities and their Applications*, Journal of Computational and Applied Mathematics, 202, (2007), (339–351).
- [5] ZIZUN LI, *Gronwall-Bellman Type Nonlinear Sums-Difference Inequalities and Applications in Difference Equations*, Journal of Mathematical Research with Applications, Jul., 2018, Vol. 38, No. 4,(393–410).
- [6] RUN XU AND XIANGTING MA, *Some new retarded nonlinear Volterra-Fredholm type integral inequalities with maxima in two variables and their applications*, Journal of Inequalities and Applications, (2017) 2017:187.
- [7] QING-HUA MA, *Estimates on some power nonlinear Volterra-Fredholm type discrete inequalities and their applications*, Journal of Computational and Applied Mathematics, 233(2010): 2170–2180.
- [8] T. H. GRONWALL, *Note on the derivatives with respect to a parameter of the solutions of a system of differential equations*, Annals of Mathematics, vol. 20, no. 4, pp. 292–296, 1919.
- [9] R. BELLMAN, *The stability of solutions of linear differential equations*, Duke Mathematical Journal, vol. 10, pp. 643–647, 1943.
- [10] L. OU-LIANG, *The boundedness of solutions of linear differential equations  $y'' + A(t)y' = 0$* , Advances in Mathematics, vol. 3, pp. 409–415, 1957.
- [11] B. G. PACHPATTE, *Inequalities for Differential and Integral Equations*, Academic Press, New York, NY, USA, 1998.
- [12] PACHPATTE, B.G., *Discrete inequalities in two variables and their applications*, Radovi Math.6 (1990), 235–247 .
- [13] SINGARE, S. M. AND PACHPATTE, B. G., *Wendroff type discrete inequalities and their applications*, Jour. Math.Phys. Sci.13, (1979), 149–167 .
- [14] E. H. YANG, *On some nonlinear integral and discrete inequalities related to Ou-Iang's inequality*, Acta Mathematica Sinica, vol. 14, no. 3, pp. 353–360, 1998.

- [15] W. S. CHEUNG AND Q. H. MA, *On certain new Gronwall-Ou-lang type integral inequalities in two variables and their applications*, Journal of Inequalities and Applications, vol. 2005, no. 4, pp. 347–361, 2005.
- [16] P. Y. H. PANG, R. P. AGARWAL, *On an integral inequality and discrete analogue*, J. Math. Anal. Appl., 194 (1995) 569–577.
- [17] LEES, M., *Approximate solutions of parabolic equations*, J. Soc. Ind. Appl. Math., 7(1959), 167–183.