

## ON NEW NONLINEAR TECHNIQUES FOR SOLVING OF SELF-ADJOINT FINITE DIFFERENCE EQUATIONS

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ABSTRACT. One of basic problems for mathematical modeling of some phenomena in bi-mathematics is appearing of complicated finite difference equations. During recent years it has been introduced some nonlinear methods which increase our ability for solving of complicated equations. One form of these type equations is self-adjoint finite difference equations. We introduce a new nonlinear technique for solving of a self-adjoint finite difference equation. Also, we investigate the existence of solution for an extended self-adjoint fractional finite difference equation under some conditions. Finally, we present an example to illustrate our result.

### REFERENCES

- [1] K. Ahrendt, L. Castle, M. Holm and K. Yochman: *Laplace transforms for the nabla-difference operator and a fractional variation of parameters formula*, Commun. Appl. Anal., **16**(2012), 317-348.
- [2] A.J. Arenasa, G. Gonzalez-Parra and B.M. Chen-Charpentier: *Construction of nonstandard finite difference schemes for the SI and SIR epidemic models of fractional order*, Math. Comput. Simulation, **121**(2016), 48-63.
- [3] F.M. Atici and P.W. Eloe: *Initial value problems in discrete fractional calculus*, Amer. Math. Soc., **137**(2009), 981-989.
- [4] P. Awasthi: *Boundary value problems for discrete fractional equations*, Ph.D. Thesis, Ann Arbor, MI, University of Nebraska-Lincoln, 2013.
- [5] D. Baleanu, K. Diethelm, E. Scalas and J.J. Trujillo: *Fractional Calculus Models and Numerical Methods*, World Scientific, 2012.
- [6] D. Baleanu, Sh. Rezapour and S. Salehi: *On some self-adjoint fractional finite difference equations*, J. Comput. Anal. Appl., **19**(2015), 59-67.
- [7] D. Baleanu, Sh. Rezapour and S. Salehi: *On the existence of solutions for a fractional finite difference inclusion via three points boundary conditions*, Adv. Diff. Eq., 2015, 2015:242, 16 pages.
- [8] D. Baleanu, Sh. Rezapour and S. Salehi: *A fractional finite difference inclusion*, J. Comput. Anal. Appl., **20**(2016), No. 5, 834-842.
- [9] I.D. Bassukas: *Comparative Gompertzian analysis of alterations of tumor growth patterns*, Cancer Research, **54**(1994), 4385-4392.
- [10] A. Brackins: *Boundary value problems of nabla fractional difference equations*, Ph.D. Thesis, University of Nebraska-Lincoln, 2014.
- [11] S.M. Garba, A.B. Gumel and J.M.S. Lubuma: *Dynamically-consistent non-standard finite difference method for an epidemic model*, Math. Comput. Model., **53**(2011), 131-150.
- [12] Ch.S. Goodrich and A.C. Peterson: *Fractional Difference Equations*, Springer-Verlag, 2015.

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- [13] Z. Jackiewicz, Z. Zobic-Kowal and B. Basse: *Finite difference and pseudo-spectral methods for the numerical simulations of in vitro human tumor cell population kinetics*, Math. Biosci. Eng., **6**(2009), No. 3, 561-572.
- [14] G. Jumarie: *Stock exchange fractional dynamics defined as fractional exponential growth driven by (usual) Gaussian white noise: Application to fractional Black-Scholes equations*, Insurance Math. Econom., **42**(2008), 271-287.
- [15] R.L. Magin: *Fractional Calculus in Bioengineering*, Bergell House, 2006.
- [16] B. Samet, C. Verto and P. Verto: *Fixed point theorem for  $\alpha$ - $\psi$ -contractive type mappings*, Nonlinear Anal., **75**(2012), 2154-2165.
- [17] A. Suryanto: *A nonstandard finite difference scheme for SIS epidemic model with delay: stability and bifurcation analysis*, Appl. Math., **3**(2012), 528-534.
- [18] S.H. Zainud-Deen, W.M. Hassen, E.M. Ali, K.H. Awadalla and H.A. Sharshar: *Breast cancer detection using a hybrid finite difference frequency domain and particle swarm optimizations techniques*, Progress in Electromagnetics Research, **3**(2008), 35-46.

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