

EXISTENCE AND UNIQUENESS OF SOLUTIONS FOR NONLINEAR FRACTIONAL NABLA DIFFERENCE SYSTEMS WITH INITIAL CONDITIONS

HAMID BOULARES, ABDELOUAHEB ARDJOUNI AND YAMINA LASKRI

Abstract. In this paper, we give sufficient conditions to guarantee the global existence and the uniqueness of solutions of nonlinear fractional nabla difference systems and study the dependence of solutions on initial conditions and parameters.

Mathematics subject classification (2010): 39A10, 39A99.

Keywords and phrases: Fractional order, nabla difference, fixed point, global existence, uniqueness, stability.

REFERENCES

- [1] S. ABBAS, *Existence of solutions to fractional order ordinary and delay differential equations and applications*, Electronic Journal of Differential Equations Vol. **2011** (2011), No. 09, pp. 1–11.
- [2] R. P. AGARWAL, V. LAKSHMIKANTHAM, J. J. NIETO, *On the concept of solution for fractional differential equations with uncertainty*, Nonlinear Anal. **72** (2009), 2859–2862.
- [3] R. P. AGARWAL, Y. ZHOU, Y. HE, *Existence of fractional functional differential equations*, Computers and Mathematics with Applications **59** (2010), 1095–1100.
- [4] G. A. ANASTASSIOU, *Discrete fractional calculus and inequalities*, arXiv:0911. 3370v1, **17** (2009).
- [5] F. M. ATICI, P. W. ELOE, *Linear systems of nabla fractional difference equations*, Rocky Mountain Journal of Mathematics **41**, 2 (2011), 353–370.
- [6] F. M. ATICI, P. W. ELOE, *Initial value problems in discrete fractional calculus*, Proc. Amer. Math. Soc. **137** (2009), 981–989.
- [7] F. M. ATICI, P. W. ELOE, *A transform method in discrete fractional calculus*, Intern. J. Difference Equ. **2** (2007), 165–176.
- [8] F. M. ATICI, P. W. ELOE, *Discrete fractional calculus with the nabla operator*, E. J. Qualitative Theory of Diff. Equ., Spec. Ed. I, **3** (2009), 1–12.
- [9] F. M. ATICI, S. SENGÜL, *Modeling with fractional difference equations*, J. Math. Anal. Appl. **369** (2010), 1–9.
- [10] M. BENCHOHRA, J. HENDERSON, S. K. NTOUYAS AND A. OUAHAB, *Existence results for fractional order functional differential equations with infinite delay*, J. Math. Anal. Appl. **338** (2008), 1340–1350.
- [11] M. BOHNER AND A. PETERSON, *Advances in Dynamic Equations on Time Scales*, Birkhauser, Boston, 2002.
- [12] T. A. BURTON, B. ZHANG, *Fractional equations and generalizations of Schaefer's and Krasnoselskii's fixed point theorems*, Nonlinear Anal. **75** (2012), 6485–6495.
- [13] F. CHEN, *Fixed points and asymptotic stability of nonlinear fractional difference equations*, Electronic Journal of Qualitative Theory of Differential Equations Vol. **2011**, No. 39, 1–18.
- [14] F. CHEN, Z. LIU, *Asymptotic Stability Results for Nonlinear Fractional Difference Equations*, Journal of Applied Mathematics Vol. **2012**, Article ID 879657, 14 pages.
- [15] F. CHEN, X. LUO, Y. ZHOU, *Existence results for nonlinear fractional difference equation*, Advances in Difference Equations **2011** (2011), Article ID 713201, 12 pages.

- [16] S. S. CHENG, W. T. PATULA, *An existence theorem for a nonlinear difference equation*, Nonlinear Anal. **20** (1993), 193–203.
- [17] K. ERWIN, *Introductory Functional Analysis with Applications*, John Wiley & Sons, Canada, 1978.
- [18] J. HEIN, S. MC CARTHY, N. GASWICK, B. MC KAIN, K. SPEAR, *Laplace transforms for the nabla difference operator*, Pan American Mathematical Journal **21**, 3 (2011), 79–96.
- [19] J. JAGAN MOHAN, *Analysis of nonlinear fractional nabla difference equations*, International Journal of Analysis and Applications Vol. **7**, No. 1 (2015), 79–95.
- [20] J. JAGAN MOHAN, N. SHOBANADEVI, G. V. S. R. DEEKSHITULU, *Stability of nonlinear nabla fractional difference equations using fixed point theorems*, Italian Journal of Pure and Applied Mathematics **32** (2014), 165–184.
- [21] A. A. KILBAS, HARI M. SRIVASTAVA, JUAN J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, in: North-Holland Mathematics Studies, Vol. 204, Elsevier Science B.V., Amsterdam, 2006.
- [22] V. LAKSHMIKANTHAM, *Theory of fractional functional differential equations*, Nonlinear Anal. **69** (2008), 3337–3343.
- [23] Y. LI, Y. CHEN, I. PODLUBNY, *Mittag-Leffler stability of fractional order nonlinear dynamic systems*, Automatica **45** (2009), 1965–1969.
- [24] K. S. MILLER, B. ROSS, *An Introduction to the Fractional Calculus and Differential Equations*, John Wiley, New York, 1993.
- [25] I. PODLUBNY, *Fractional Differential Equations*, Academic Press, San Diego, 1999.
- [26] G. SAMKO, A. A. KILBAS, O. I. MARICHEV, *Fractional Integrals and Derivatives: Theory and Applications*, Gordon and Breach, Yverdon, 1993.
- [27] D. R. SMART, *Fixed point theorems*, Cambridge Uni. Press., Cambridge, 1980.
- [28] Y. ZHOU, F. JIAO, J. LI, *Existence and uniqueness for p -type fractional neutral differential equations*, Nonlinear Anal. **71** (2009), 2724–2733.
- [29] A. THABET, *On Riemann and Caputo fractional differences*, Computers and Mathematics with Applications **62** (2011), 1602–1611.
- [30] A. THABET, F. M. ATICI, *On the definitions of nabla fractional operators*, Abstract and Applied Analysis, Volume **2012**, Article ID 406757, 13 Pages.
- [31] Y. ZHOU, F. JIAO, J. LI, *Existence and uniqueness for fractional neutral differential equations with infinite delay*, Nonlinear Anal. **71** (2009), 3249–3256.