

SOME EXISTENCE RESULTS FOR FRACTIONAL DIFFERENTIAL INCLUSIONS VIA FIXED POINT THEOREMS

VAHID ROOMI*, HOJJAT AFSHARI** AND SABLEH KALANTARI***

*Department of Mathematics, Azarbaijan Shahid Madani University, Tabriz, Iran
E-mail: roomi@azaruniv.ac.ir
(Corresponding author)

**Department of Mathematics, Basic Science Faculty, University of Bonab, Bonab, Iran
E-mail: hojat.afshari@yahoo.com

***Department of Mathematics, Azarbaijan Shahid Madani University, Tabriz, Iran
E-mail: kalantari.math@gmail.com

Abstract. This paper is generally concerned with the existence of solutions for a certain class of fractional differential inclusions with boundary conditions. By means a known fixed point theorem, some existence results are obtained. Utilizing some contractions including $\alpha - \phi$ -Geraghty contraction, we examine the existence of solutions for some fractional differential inclusions. An example is given to illustrate the results.

Key Words and Phrases: Fixed point, fractional differential inclusion, integral boundary value problems, multifunction.

2020 Mathematics Subject Classification: 47H10, 34A08.

Acknowledgment. The authors would like to thank anonymous referees for their carefully reading the manuscript and such valuable comments, which has improved the manuscript significantly.

REFERENCES

- [1] H. Afshari, H.H. Alsulami, E. Karapinar, *On the extended multivalued Geraghty type contractions*, J. Nonlinear Sci. Appl., **9**(2016), 4695-4706.
- [2] H. Afshari, H. Aydi, E. Karapinar, *Existence of fixed points of set-valued mappings in b-metric spaces*, East Asian Math. J., **32**(2016), no. 3, 319-332.
- [3] H. Afshari, S. Kalantari, D. Baleanu, *Solution of fractional differential equations via $\alpha - \psi$ -Geraghty type mappings*, Advances in Difference Equations, (2018), 2018:347.
- [4] R.P. Agarwal, B. Ahmad, *Existence theory for anti-periodic boundary value problems of fractional differential equations and inclusions*, J. Appl. Math. Comput., **62**(2011), 1200-1214.
- [5] R.P. Agarwal, D. Baleanu, V. Hedayati, S. Rezapour, *Two fractional derivative inclusion problems via integral boundary condition*, J. Appl. Math. Comput., **257**(2015), 205-212.
- [6] R.P. Agarwal, M. Belmekki, M. Benchohra, *A survey on semilinear differential equations and inclusions involving Riemann-Liouville fractional derivative*, Adv. Diff. Eq., (2009), Article ID 981728, 47 pages.

- [7] R.P. Agarwal, M. Benchohra, S. Hamani, *A survey on existence results for boundary value problems of nonlinear fractional differential equations and inclusions*, Acta Appl. Math., **109**(2010), 973-1033.
- [8] R.P. Agarwal, M. Meehan, D. O'Regan, *Fixed Point Theory and Applications*, Cambridge University Press, 2004.
- [9] B. Ahmad, J.J. Nieto, *Existence of solutions for anti-periodic boundary value problems involving fractional differential equations via Leray-Schauder degree theory*, Topol. Methods Nonlinear Anal., **35**(2010), 295-304.
- [10] B. Ahmad, S.K. Ntouyas, *Boundary value problem for Fractional differential inclusions with four-point integral boundary conditions*, Surveys Math. Appl., **6**(2011), 175-193.
- [11] R. Ameen, F. Jarad, T. Abdeljawad, *Ulam stability for delay fractional differential equations with a generalized Caputo derivative*, Filomat, **32**(15)(2018), 5265-5274.
- [12] G.A. Anastassiou, *Principles of delta fractional calculus on time scales and inequalities*, Math. Comput. Model., **52**(2010), 556-566.
- [13] M. Benchohra, N. Hamidi, *Fractional order differential inclusions on the Half-Lin*, Surveys Math. Appl., **5**(2010), 99-111.
- [14] M. Benchohra, S.K. Ntouyas, *On second order differential inclusions with periodic boundary conditions*, Acta Math. Univ. Comenianae, **69**(2000), no. 2, 173-181.
- [15] K. Deimling, *Multi-valued Differential Equations*, Walter de Gruyter, Berlin, 1992.
- [16] B.D. Dhage, *Fixed point theorems for discontinuous multivalued operators on ordered spaces with applications*, Computer Math. Appl., **51**(2006), 589-604.
- [17] A.M.A. El-Sayed, A.G. Ibrahim, *Multivalued fractional differential equations*, Appl. Math. Comput., **68**(1995), 15-25.
- [18] A.A. Kilbas, H.M. Srivastava, J.J. Trujillo, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, Elsevier Science, 2006.
- [19] M. Kisielewicz, *Differential Inclusions and Optimal Control*, Kluwer, Dordrecht, 1991.
- [20] X. Liu, Z., Liu, *Existence result for fractional differential inclusions with multivalued term depending on lower-order derivative*, Abstract and Applied Analysis, (2012), Article ID 423796, 24 pages.
- [21] H.R. Marasi, H. Afshari, M. Daneshbastam, C.B. Zhai, *Fixed points of mixed monotone operators for existence and uniqueness of nonlinear fractional differential equations*, J. Contemporary Mathematical Analysis, **52**(2017), p. 8C13.
- [22] A. Ouahab, *Some results for fractional boundary value problem of differential inclusions*, Nonlinear Analysis, **69**(2008), 3877-3896.
- [23] I. Podlubny, *Fractional Differential Equations*, Academic Press, 1999.
- [24] B. Samet, C. Vetro, P. Vetro, *Fixed point theorems for α - ψ -contractive type mappings*, Nonlinear Analysis, **75**(2012), 2154-2165.
- [25] S.G. Samko, A.A. Kilbas, O.I. Marichev, *Fractional Integrals and Derivatives: Theory and Applications*, Gordon and Breach, Yverdon, 1993.
- [26] X. Su, *Boundary value problem for a coupled system of nonlinear fractional differential equations*, Appl. Math. Letters, **22**(2009), 64-69.

Received: November 10, 2020; Accepted: June 14, 2021.

