

PERIODIC SOLUTIONS FOR NONLINEAR FRACTIONAL DIFFERENTIAL SYSTEMS

SAÏD ABBAS, MOUFFAK BENCHOHRA, SOUFYANE BOURIAH AND JUAN J. NIETO

Abstract. In this paper, we establish some existence and uniqueness results for periodic solutions for a class of fractional differential equations with the Caputo fractional derivative. The arguments are based upon the Banach contraction principle, and Schaefer's fixed point theorem.

Mathematics subject classification (2010): 26A33.

Keywords and phrases: Fractional differential equation, existence, uniqueness, periodic solution, Banach contraction principle, Schaefer's fixed point theorem.

REFERENCES

- [1] S. ABBAS AND M. BENCHOHRA, *On the generalized Ulam-Hyers-Rassias stability for Darboux problem for partial fractional implicit differential equations*, Appl. Math. E-Notes **14** (2014), 20–28.
- [2] S. ABBAS, M. BENCHOHRA, J. GRAEF AND J. HENDERSON, *Implicit Fractional Differential and Integral Equations; Existence and Stability*, De Gruyter, Berlin, 2018.
- [3] S. ABBAS, M. BENCHOHRA AND G. M. N'GUÉRÉKATA, *Topics in Fractional Differential Equations*, Springer-Verlag, New York, 2012.
- [4] S. ABBAS, M. BENCHOHRA AND G. M. N'GUÉRÉKATA, *Advanced Fractional Differential and Integral Equations*, Nova Science Publishers, New York, 2015.
- [5] R. P. AGARWAL, M. BENCHOHRA AND 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.
- [6] M. BENCHOHRA AND S. BOURIAH, *Existence and stability results for nonlinear boundary value problem for implicit differential equations of fractional order*, Moroccan J. Pure Appl. Anal. **1** (1) (2017), 22–37.
- [7] M. BENCHOHRA, S. BOURIAH, AND J. J. NIETO, *Existence of periodic solutions for nonlinear implicit Hadamard fractional differential equations*, Rev. R. Acad. Cienc. Exactas Fis. Nat. Ser. A Math. RACSAM **112** (2018), 25–35.
- [8] M. BENCHOHRA, S. BOURIAH, J. E. LAZREG, AND J. J. NIETO, *Nonlinear Implicit Hadamard fractional differential equations with delay in Banach space*, Acta Univ. Palack. Olomuc. Fac. Rerum Natur. Math. **55** (2016), 15–26.
- [9] M. BENCHOHRA AND J. E. LAZREG, *Nonlinear fractional implicit differential equations*, Commun. Appl. Anal. **17** (2013), 471–482.
- [10] G. CHAI, *Existence results for anti-periodic boundary value problems of fractional differential equations*, Adv. Difference Equ. **2013**, 2013:53, 15 pp.
- [11] K. DIETHELM, *The Analysis of Fractional Differential Equations*, Springer, Berlin, 2010.
- [12] X. L. DIND, *Controllability and optimality of linear time-invariant neutral control systems with different fractional orders*, Acta Math. Sci. **35B** (5) (2015), 1003–1013.
- [13] A. GRANAS AND J. DUGUNDJI, *Fixed Point Theory*, Springer-Verlag, New York, 2003.
- [14] T. GUO, W. JIANG, *Impulsive fractional functional differential equations*, Comput. Math. Appl. **64** (2012), 3414–4324.
- [15] A. A. KILBAS, H. M. SRIVASTAVA AND J. J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, 204. Elsevier Science B. V., Amsterdam, 2006.

- [16] K. S. MILLER, B. ROSS, *An Introduction to the Fractional Calculus and Differential Equations*, Wiley, New York, 1993.
- [17] I. PODLUBNY, *Fractional Differential Equations*, Academic Press, San Diego, 1999.
- [18] J. SHENG AND W. JIANG, *Existence and uniqueness of the solution of fractional damped dynamical systems*, Adv. Difference Equ. **2017**, paper no. 16, 14 pp.
- [19] V. E. TARASOV, *Fractional Dynamics: Application of Fractional Calculus to Dynamics of Particles, Fields and Media*, Springer, Berlin, 2011.
- [20] H. YE, J. GAO AND Y. DING, *A generalized Gronwall inequality and its application to a fractional differential equation*, J. Math. Anal. Appl. **328** (2007), 1075–1081.
- [21] Y. ZHOU, *Basic Theory of Fractional Differential Equations*, World Scientific, Singapore, 2014.