

## WEAKLY PICARD OPERATORS METHOD FOR MODIFIED FRACTIONAL ITERATIVE FUNCTIONAL DIFFERENTIAL EQUATIONS

JINRONG WANG\*, MICHAL FEČKAN\*\* AND YONG ZHOU\*\*\*

\* Department of Mathematics, Guizhou University  
Guiyang, Guizhou 550025, P. R. China

\*\* Department of Mathematical Analysis and Numerical Mathematics  
Faculty of Mathematics, Physics and Informatics, Comenius University  
Mlynská dolina, 842 48 Bratislava, Slovakia

\*\*\* Department of Mathematics, Xiangtan University  
Xiangtan, Hunan 411105, P. R. China

E-mail: wjr9668@126.com; Michal.Feckan@fmph.uniba.sk; yzhou@xtu.edu.cn

**Abstract.** Boundary value problems for modified fractional iterative functional differential equations is offered. Using weakly Picard operators method, some new existence and uniqueness theorems and data dependence results are presented. Further, examples are given to illustrate our results.

**Key Words and Phrases:** Weakly Picard operators, fractional iterative functional differential equations, boundary value problems.

**2010 Mathematics Subject Classification:** 26A33, 34B37, 47H10.

**Acknowledgement.** The first author's work was supported by Key Projects of Science and Technology Research in the Chinese Ministry of Education (211169) and Tianyuan Special Funds of the National Natural Science Foundation of China (11026102); The second author's work was partially supported by Grants VEGA-MS 1/0507/11 and APVV-0414-07; the third author's work was supported by National Natural Science Foundation of China (10971173).

### REFERENCES

- [1] I.A. Rus, *Metrical fixed point theorems*, Univ. of Cluj-Napoca, Romania, 1979.
- [2] I.A. Rus, *Picard mappings: results and problems*, Seminar on Fixed Point Theory, Preprint no. **3**(1987), 55-64.
- [3] I.A. Rus, *Weakly Picard mappings*, Comment. Math. Univ. Carolinae, **34**(1993), 769-773.
- [4] I.A. Rus, S. Mureşan, *Data dependence of the fixed points set of some weakly Picard operators*, In: Proc. Itinerant Seminar (Elena Popoviciu-Ed.), Srima Publishing House, Cluj-Napoca, 2000, 201-207.
- [5] I.A. Rus, *Functional-differential equations of mixed type, via weakly Picard operators*, Seminar on Fixed Point Theory, Cluj-Napoca, 2002, 335-345.
- [6] I.A. Rus, *Picard operators and applications*, Sci. Math. Jpn., **58**(2003), 191-219.
- [7] I.A. Rus, E. Egri, *Boundary value problems for iterative functional-differential equations*, Studia Univ. Babeş-Bolyai, Mathematica, **51**(2006), 109-126.

- [8] M.A. Şerban, I.A. Rus, A. Petruşel, *A class of abstract Volterra equations, via weakly Picard operators technique*, Math. Ineq. Appl., **13**(2010), 255-269.
- [9] V. Mureşan, *Existence, uniqueness and data dependence for the solutions of some integro-differential equations of mixed type in Banach space*, J. Anal. Appl., **23**(2004), 205-216.
- [10] V. Mureşan, *Volterra integral equations with iterations of linear modification of the argument*, Novi Sad J. Math., **33**(2003), 1-10.
- [11] I.M. Olaru, *An integral equation via weakly Picard operators*, Fixed Point Theory, **11**(2010), 97-106.
- [12] J. Wang, Y. Zhou, M. Medveď, *Picard and weakly Picard operators technique for nonlinear differential equations in Banach spaces*, J. Math. Anal. Appl., **389**(2012), 261-274.
- [13] K. Diethelm, *The Analysis of Fractional Differential Equations*, Lecture Notes in Mathematics, 2010.
- [14] A.A. Kilbas, H.M. Srivastava, J.J. Trujillo, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, vol. 204, Elsevier Science B.V., Amsterdam, 2006.
- [15] K.S. Miller, B. Ross, *An Introduction to the Fractional Calculus and Differential Equations*, John Wiley, New York, 1993.
- [16] I. Podlubny, *Fractional Differential Equations*, Academic Press, San Diego, 1999.
- [17] V.E. Tarasov, *Fractional Dynamics: Application of Fractional Calculus to Dynamics of Particles, Fields and Media*, Springer, HEP, 2010.
- [18] 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.
- [19] B. Ahmad, J.J. Nieto, *Existence results for a coupled system of nonlinear fractional differential equations with three-point boundary conditions*, Comput. Math. Appl., **58**(2009), 1838-1843.
- [20] Z. Bai, *On positive solutions of a nonlocal fractional boundary value problem*, Nonlinear Anal., **72**(2010), 916-924.
- [21] M. Benchohra, J. Henderson, S.K. Ntouyas, A. Ouahab, *Existence results for fractional order functional differential equations with infinite delay*, J. Math. Anal. Appl., **338**(2008), 1340-1350.
- [22] Y.-K. Chang, J.J. Nieto, *Some new existence results for fractional differential inclusions with boundary conditions*, Math. Comput. Model., **49**(2009), 605-609.
- [23] M. Fečkan, Y. Zhou, J. Wang, *On the concept and existence of solution for impulsive fractional differential equations*, Commun. Nonlinear Sci. Numer. Simulat., **17**(2012), 3050-3060.
- [24] J. Wang, Y. Zhou, *A class of fractional evolution equations and optimal controls*, Nonlinear Anal. Real World Appl., **12**(2011), 262-272.
- [25] J. Wang, Y. Zhou, *Analysis of nonlinear fractional control systems in Banach spaces*, Nonlinear Anal., **74**(2011), 5929-5942.
- [26] J. Wang, Y. Zhou, *Existence and controllability results for fractional semilinear differential inclusions*, Nonlinear Anal. Real World Appl. **12**(2011), 3642-3653.
- [27] J. Wang, M. Fečkan, Y. Zhou, *On the new concept of solutions and existence results for impulsive fractional evolution equations*, Dynam. Part. Differ. Eq., **8**(2011), 345-361.
- [28] S. Zhang, *Existence of positive solution for some class of nonlinear fractional differential equations*, J. Math. Anal. Appl., **278**(2003), 136-148.
- [29] Y. Zhou, F. Jiao, J. Li, *Existence and uniqueness for fractional neutral differential equations with infinite delay*, Nonlinear Anal., **71**(2009), 3249-3256.
- [30] Y. Zhou, F. Jiao, *Nonlocal Cauchy problem for fractional evolution equations*, Nonlinear Anal., RWA, **11**(2010), 4465-4475.
- [31] M. Fečkan, *On a certain type of functional differential equations*, Math. Slovaca, **43**(1993), 39-43.
- [32] S.S. Cheng, J.G. Si, X.P. Wang, *An existence theorem for iterative functional differential equations*, Acta Math. Hungar., **94**(2002), 1-17.

*Received: March 29, 2012; Accepted: June 11, 2012.*