

## EXISTENCE AND UNIQUENESS RESULTS FOR GENERALIZED CAPUTO ITERATIVE FRACTIONAL BOUNDARY VALUE PROBLEMS

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**Abstract.** In this paper, we present some results on existence and uniqueness for a class of boundary value problems for iterative fractional differential equations with generalized Caputo fractional derivative. For our proofs, we employ some suitable fixed point theorems. Finally, we provide an illustration for more clarity.

*Mathematics subject classification (2020):* 26A33, 34K10, 34A08, 34K37.

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### REFERENCES

- [1] S. ABBAS, M. BENCHOHRA AND G. M. N'GUÉRÉKATA, *Topics in Fractional Differential Equations*, Springer-Verlag, New York, 2012.
- [2] S. ABBAS, M. BENCHOHRA AND G. M. N'GUÉRÉKATA, *Advanced Fractional Differential and Integral Equations*, Nova Science Publishers, New York, 2014.
- [3] M. I. ABBAS, M. GHADERI, SH. REZAPOUR, S. T. M. THABET, *On a Coupled System of Fractional Differential Equations via the Generalized Proportional Fractional Derivatives*, Journal of Function Spaces **2022** (2022), 1–10, <https://doi.org/10.1155/2022/4779213>.
- [4] R. ALMEIDA, A. B. MALINOWSKA AND T. ODZIJEWICZ, *Fractional differential equations with dependence on the Caputo-Katugampola derivative*, J. Comput. Nonlinear Dynam. **11** (6): 11 pages, 2016.
- [5] B. AL-SAQABI, V. S. KIRYAKOVA, *Explicit solutions of fractional integral and differential equations involving Erdélyi-Kober operators*, Appl. Math. Comput. **95** (1998), 1–13.
- [6] M. BENCHOHRA, F. BOUAZZAOUI, E. KARAPINAR AND A. SALIM, *Controllability of second order functional random differential equations with delay*, Mathematics. **10** (2022), 16 pp, <https://doi.org/10.3390/math10071120>.
- [7] M. BOUMAAZA, M. BENCHOHRA AND JUAN J. NIETO, *Caputo type modification of the Erdélyi-Kober coupled implicit fractional differential systems with retardation and anticipation*, Differ. Equ. Appl. **2** (2021) 101–114.
- [8] C. DERBAZI, H. HAMMOUCHE, A. SALIM AND M. BENCHOHRA, *Measure of noncompactness and fractional Hybrid differential equations with Hybrid conditions*, Differ. Equ. Appl. **14** (2022), 145–161, <http://dx.doi.org/10.7153/dea-2022-14-09>.
- [9] E. R. KAUFMANN, *A fourth-order iterative boundary value problem with Lidstone boundary conditions*, Differ. Equ. Appl. **14** (2022) 305–312.
- [10] E. R. KAUFMANN, *Existence and uniqueness of solutions for a second-order iterative boundary-value problem*, Electron. J. Differential Equations. **2018** (2018) 1–6.
- [11] A. GUERFI AND A. ARDJOUNI, *Existence, uniqueness, continuous dependence and Ulam stability of mild solutions for an iterative fractional differential equation*, CUBO, A Mathematical Journal. **24** (2022) 83–94.
- [12] A. GUERFI AND A. ARDJOUNI, *Existence of nonnegative solutions for a hybrid nonlinear differential equation with iterative terms*, Acta Math. Univ. Comenianae. **2** (2022) 141–148.
- [13] A. GRANAS AND J. DUGUNDJI, *Fixed Point Theory*, Springer-Verlag, New York, 2003.

- [14] A. HERIS, A. SALIM, M. BENCHOHRA AND E. KARAPINAR, *Fractional partial random differential equations with infinite delay*, Results in Physics. (2022), <https://doi.org/10.1016/j.rinp.2022.105557>.
- [15] R. HILFER, *Applications of Fractional Calculus in Physics*, World Scientific, Singapore, 2000.
- [16] U. N. KATUGAMPOLA, *A new approach to generalized fractional derivatives*, Bull. Math. Anal. Appl. **6** (4) (2014), 1–15.
- [17] U. N. KATUGAMPOLA, *New approach to a generalized fractional integral*, Appl. Math. Comput. **218** (3) (2011), 860–865.
- [18] A. A. KILBAS, HARI M. SRIVASTAVA, AND JUAN J. TRUJILLO, *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, 204. Elsevier Science B.V., Amsterdam, 2006.
- [19] V. KIRYAKOVA, *Generalized Fractional Calculus and Applications*, Pitman Research Notes in Math. 301, Longman, Harlow – J. Wiley, New York, 1994.
- [20] N. LALEDJ, A. SALIM, J. E. LAZREG, S. ABBAS, B. AHMAD AND M. BENCHOHRA, *On implicit fractional  $q$ -difference equations: Analysis and stability*, Math Meth Appl Sci. **45** (2022), 1–23, <https://doi.org/10.1002/mma.8417>.
- [21] J. E. LAZREG, M. BENCHOHRA AND A. SALIM, *Existence and Ulam stability of  $k$ -Generalized  $\psi$ -Hilfer Fractional Problem*, J. Innov. Appl. Math. Comput. **2** (2022), 01–13.
- [22] Y. LUCHKO AND J. J. TRUJILLO, *Caputo-type modification of the Erdélyi-Kober fractional derivative*, Fract. Calc. Appl. Anal. **10** (3) (2007), 249–267.
- [23] D. S. OLIVEIRA, E. CAPELAS DE OLIVEIRA, *Hilfer-Katugampola Fractional derivative*, Comput. Appl. Math. **37** (2018), 3672–3690.
- [24] SH. REZAPOUR, S. T. M. THABET, M. M. MATAR, J. ALZABUT, S. ETEMAD, *Some Existence and Stability Criteria to a Generalized FBVP Having Fractional Composite  $p$ -Laplacian Operator*, Journal of Function Spaces. **2021** (2021), 1–10, <https://doi.org/10.1155/2021/9554076>.
- [25] A. SALIM, S. ABBAS, M. BENCHOHRA AND E. KARAPINAR, *Global stability results for Volterra-Hadamard random partial fractional integral equations*, Rend. Circ. Mat. Palermo (2) (2022), 1–13, <https://doi.org/10.1007/s12215-022-00770-7>.
- [26] A. SALIM, M. BENCHOHRA, J. R. GRAEF AND J. E. LAZREG, *Initial value problem for hybrid  $\psi$ -Hilfer fractional implicit differential equations*, J. Fixed Point Theory Appl. **24** (2022), 14 pp, <https://doi.org/10.1007/s11784-021-00920-x>.
- [27] A. SALIM, J. E. LAZREG, B. AHMAD, M. BENCHOHRA AND J. J. NIETO, *A Study on  $k$ -Generalized  $\psi$ -Hilfer Derivative Operator*, Vietnam J. Math. (2022), <https://doi.org/10.1007/s10013-022-00561-8>.
- [28] S. T. M. THABET, M. B. DHAKNE, *On abstract fractional integro-differential equations via measure of noncompactness*, Adv. Fixed Point Theory **6** (2016), 175–193.
- [29] S. B. YAKUBOVICH, Y. F. LUCHKO, *The Hypergeometric Approach to Integral Transforms and Convolutions*, Mathematics and its Appl. 287, Kluwer Acad. Publ., Dordrecht-Boston-London, 1994.
- [30] Y. ZHOU, *Basic Theory of Fractional Differential Equations*, World scientific, 2014.