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*A global uniqueness result for fractional order implicit differential equations*

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**Abstract:** In this paper we investigate the global existence and uniqueness of solutions for the initial value problems (IVP for short), for a class of implicit hyperbolic fractional order differential equations by using a nonlinear alternative of Leray-Schauder type for contraction maps on Fréchet spaces.

**Keywords:** partial hyperbolic differential equation, fractional order, left-sided mixed Riemann-Liouville integral, mixed regularized derivative, solution, Fréchet space, fixed point

**AMS Subject Classification:** 26A33

#### REFERENCES

- [1] Abbas S., Agarwal R.P., Benchohra M., *Darboux problem for impulsive partial hyperbolic differential equations of fractional order with variable times and infinite delay*, Nonlinear Anal. Hybrid Syst. **4** (2010), 818–829.
- [2] Abbas S., Benchohra M., *Partial hyperbolic differential equations with finite delay involving the Caputo fractional derivative*, Commun. Math. Anal. **7** (2009), 62–72.
- [3] Abbas S., Benchohra M., *The method of upper and lower solutions for partial hyperbolic fractional order differential inclusions with impulses*, Discuss. Math. Differ. Incl. Control Optim. **30** (2010), no. 1, 141–161.
- [4] Abbas S., Benchohra M., Gorniewicz L., *Existence theory for impulsive partial hyperbolic fractional differential equations involving the Caputo fractional derivative*, Sci. Math. Jpn. **72** (2010), 49–60.
- [5] Abbas S., Benchohra M., N’Guérékata G.M., *Topics in Fractional Differential Equations*, Developments in Mathematics, 27, Springer, New York, 2012.
- [6] Abbas S., Benchohra M., Vityuk A.N., *On fractional order derivatives and Darboux problem for implicit differential equations*, Fract. Calc. Appl. Anal. **15** (2) (2012), 168–182.
- [7] Belarbi A., Benchohra M., Ouahab A., *Uniqueness results for fractional functional differential equations with infinite delay in Fréchet spaces*, Appl. Anal. **85** (2006), 1459–1470.
- [8] Benchohra M., Graef J.R., Hamani S., *Existence results for boundary value problems of nonlinear fractional differential equations with integral conditions*, Appl. Anal. **87** (2008), no. 7, 851–863.
- [9] Benchohra M., Hamani S., Ntouyas S.K., *Boundary value problems for differential equations with fractional order*, Surv. Math. Appl. **3** (2008), 1–12.
- [10] Benchohra M., Henderson J., Ntouyas S.K., Ouahab A., *Existence results for functional differential equations of fractional order*, J. Math. Anal. Appl. **338** (2008), 1340–1350.
- [11] Frigon M., Granas A., *Résultats de type Leray-Schauder pour des contractions sur des espaces de Fréchet*, Ann. Sci. Math. Québec **22** (1998), no. 2, 161–168.
- [12] Henry D., *Geometric Theory of Semilinear Parabolic Partial Differential Equations*, Springer, Berlin-New York, 1989.
- [13] Hilfer R., *Applications of Fractional Calculus in Physics*, World Scientific, Singapore, 2000.
- [14] Kilbas A.A., Srivastava H.M., Trujillo J.J., *Theory and Applications of Fractional Differential Equations*, North-Holland Mathematics Studies, 204, Elsevier Science B.V., Amsterdam, 2006.
- [15] Kilbas A.A., Marzan S.A., *Nonlinear differential equations with the Caputo fractional derivative in the space of continuously differentiable functions*, Differ. Equ. **41** (2005), 84–89.
- [16] Miller K.S., Ross B., *An Introduction to the Fractional Calculus and Differential Equations*, John Wiley, New York, 1993.
- [17] Oldham K.B., Spanier J., *The Fractional Calculus*, Academic Press, New York, London, 1974.
- [18] Podlubny I., *Fractional Differential Equation*, Academic Press, San Diego, 1999.

- [19] Samko S.G., Kilbas A.A., Marichev O.I., *Fractional Integrals and Derivatives. Theory and Applications*, Gordon and Breach, Yverdon, 1993.
- [20] Vityuk A.N., *Existence of solutions of partial differential inclusions of fractional order*, *Izv. Vyssh. Uchebn. Zaved. Mat.* **8** (1997), 13–19.
- [21] Vityuk A.N., Golushkov A.V., *Existence of solutions of systems of partial differential equations of fractional order*, *Nonlinear Oscil.* **7** (2004), no. 3, 318–325.
- [22] Vityuk A.N., Mykhailenko A.V., *On a class of fractional-order differential equation*, *Nonlinear Oscil.* **11** (2008), no. 3, 307–319.
- [23] Vityuk A.N., Mykhailenko A.V., *The Darboux problem for an implicit fractional-order differential equation*, *J. Math. Sci.* **175** (4) (2011), 391–401.