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AN EXISTENCE RESULT FOR A SEQUENTIAL FRACTIONAL DIFFERENTIAL EQUATION WITH IMPULSIVE CONDITIONS

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Abstract. In this article, we investigate the existence of solutions for a sequential fractional differential equation with impulsive conditions in an appropriate Banach space. Our method is based on a combination between the Meir-Keeler fixed point theorem and the Kuratowski measure of non-compactness, an example is presented to clarify our method.

Keywords. Measure of non-compactness, Meir-Keeler condensing operators, Banach space, fixed point theorem, Riemann-Liouville fractional derivative.

AMS (MOS) subject classification: 26A33, 34A60, 34A08, 34A37.

1 Introduction

Fractional differential equations can be found in most fields of science and engineering [16, 17, 19, 22]. Many processes in physics, population dynamics, biology, and medicine may experience sudden changes in their dynamics, such as shocks or perturbations, so most researchers seek to model these phenomenons into impulsive fractional differential equations that can be studied, see [1, 3, 5].

Theoretical study of initial and boundary value problems for differential equations with impulses recently has developed by Fečkan et al. [13] when they had given a revised formula for the solutions of an impulsive differential equation involving the Caputo derivative. In the references [6, 10], the authors are interested in the study of impulsive differential equations involving the derivative of Riemann or that of Hilfer.

Recently, several papers have been published on the study of fractional differential equations over Banach spaces. Some of these papers used some fundamental functional analysis tools and fractional calculs to examine the existence results of solutions and its properties, see [4, 7, 8, 18, 20, 21].

In [11], M. Beddani et al. studied the existence result for the following system

$$(\mathbf{P}): \quad \begin{cases} {}^{rl}D^{\alpha}_{0^+} y'(t) = f(t, y(t), y'(t)), \quad t \in (0, T], \\ I^{1-\alpha}_{0^+} y'(0) = a, \\ y(0) = b, \end{cases}$$

where $0 < \alpha < 1$, ${}^{rl}D^{\alpha}_{0^+}$ and $I^{1-\alpha}_{0^+}$ denote respectively the left-sided Riemann-Liouville fractional derivative and the left-sided Riemann-Liouville fractional integral. In view of the above