

# NONLOCAL BOUNDARY VALUE PROBLEMS FOR LANGEVIN FRACTIONAL DIFFERENTIAL INCLUSIONS WITH RIEMANN-LIOUVILLE FRACTIONAL INTEGRAL BOUNDARY CONDITIONS

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**Abstract.** In this paper we study a boundary value problem consisting from a fractional differential inclusion of Caputo-Langevin type subject to Riemann-Liouville fractional integral conditions. Some new existence results for convex as well as non-convex multivalued maps are obtained by using standard fixed point theorems. The obtained results are illustrated by examples.

**Keywords.** Riemann-Liouville fractional derivative; fractional differential inclusions; existence; fixed point theorems.

**AMS (MOS) subject classification:** 34A60; 34A08; 34B15.

## 1 Introduction

Fractional differential equations have been shown to be very useful in the study of models of many phenomena in various fields of science and engineering, such as physics, chemistry, biology, signal and image processing, biophysics, blood flow phenomena, control theory, economics, aerodynamics and fitting of experimental data. For examples and recent development of the topic, see ([1-13]) and references cited therein.

The Langevin equation (first formulated by Langevin in 1908) is found to be an effective tool to describe the evolution of physical phenomena in fluctuating environments [14]. For some new developments on the fractional Langevin equation, see, for example, [15-23].