Nonlinear Analysis 128 (2015) 149–175

Contents lists available at ScienceDirect

Nonlinear Analysis

www.elsevier.com/locate/na

Existence results for an impulsive neutral stochastic fractional integro-differential equation with infinite delay

Alka Chadha, Dwijendra N. Pandey*

Department of Mathematics, Indian Institute of Technology Roorkee, Roorkee 247667, India

ARTICLE INFO

Article history:
Received 18 September 2014
Accepted 19 July 2015
Communicated by Enzo Mitidieri

MSC:
34G20
34K37
34K45
35R12
45J05
60H15
60H20

Keywords:
Resolvent operator
Impulsive differential equation
Fixed point theorem
Neutral integro-differential equation
Stochastic differential equation

ABSTRACT

In this work, we consider an impulsive neutral stochastic fractional integro-differential equation with infinite delays in an arbitrary separable Hilbert space. The existence of mild solution is obtained by using resolvent operator and fixed point theorems. An example is considered to illustrate the theory and conclusion is also provided at the end of the manuscript.

1. Introduction

In recent two decades, fractional calculus has grabbed the attention of many researchers and remarkable contributions have been made to both theory and applications of fractional differential equations. Fractional equations have an incredible applications in various sciences such as material sciences, mechanics, seepage flow in porous media, in fluid dynamic traffic models, population dynamics, economics, chemical technology, medicine and many other related fields.

* Corresponding author.
E-mail addresses: alkachadda23@gmail.com (A. Chadha), dwij.iitr@gmail.com (D.N. Pandey).

http://dx.doi.org/10.1016/j.na.2015.07.018
0362-546X/

In fact, fractional differential equations are considered as an option model for nonlinear partial differential equations. The nonlinear oscillations of earthquake can be described by the fractional differential equations. The details on the theory and its applications can be found in books [27,40,22,30] and references given therein. Many physical and engineering problems, for example, fluid dynamics, electronics and kinetics can be modeled in the form of the integro-differential equation. Integro-differential equation of neutral type with delay can be described the system of rigid heat conduction with finite wave spaces. For more details, we refer to monograph [16,20] and papers [12,18,19,17,31,10]. Moreover, the state of many phenomena and processes considered in optimal control theory, biology, biotechnologies, etc. are frequently subject to instantaneous perturbation and experiences sudden changes (impulses) at specific moments of time. The length of the time of these changes is very small and negligible in comparison with the total duration of the process considered. Such processes and phenomena with short-term external influences can be modeled as impulsive differential equation. For the general theory of such differential equations, we refer to the monographs [23,5] and recent results can be found in [42,14,10,6,7,25,2,39,44,45].

On the other hand, the investigation of stochastic differential equation has been picking up much importance and attention of researchers due to its wide applicability in science and engineering. Since arbitrary fluctuations are regular in the real world, scientific (mathematical) models for complex systems are frequently subject to instabilities, for example, indeterminate parameters, fluctuating powers, or random boundary conditions. Also, uncertainties may be created by the absence of knowledge of some chemical, physical or biological systems that are not well known, and in this manner are not suitably represented (or missed totally) in the scientific models. Despite the fact that these fluctuations and unrepresented systems may be extremely little or quick, their long-term effect on the system evolution may be delicate or even meaningful. This kind of delicate effects on the general evolution of dynamical systems has been seen in, for instance, stochastic resonance, stochastic bifurcation and noise-induced pattern development. In this way considering stochastic impacts is of central significance for mathematical modeling of complex systems under uncertainty. Thus, a large number of these systems can be modeled by stochastic differential equations, for example, price processes, exchange rates, and interest rates, among others in finance.

The existence, uniqueness, stability and qualitative analysis of the mild solutions of stochastic differential equations have been studied by many authors. In [28], author has obtained sufficient conditions for the existence and uniqueness of solution of stochastic differential equations under uniform Lipschitz and the linear growth condition. In [26], author has shown that there exists the unique solution for neutral stochastic functional differential equation under uniform Lipschitz and the linear growth condition. The approximate controllability of nonlocal neutral stochastic fractional differential equations is studied by authors in [13]. In [3], authors have considered an impulsive stochastic semilinear neutral functional differential eqnarrays with infinite delays and discussed the existence, uniqueness and stability of mild solutions of considered stochastic differential equations with a Lipschitz condition and without a Lipschitz condition by utilizing the technique of successive approximations. In [44], authors have discussed the existence of solutions to impulsive fractional partial neutral stochastic integro-differential inclusions with state-dependent delay. The asymptotic stability of fractional impulsive neutral stochastic partial integro-differential equations with state-dependent delay is studied by the authors in [45]. The existence and uniqueness of square-mean almost automorphic solutions for some stochastic differential equations have been studied by authors in [15] in which the asymptotic stability of the unique square-mean almost automorphic solution in the square-mean sense has been discussed. In [21], authors have considered an impulsive neutral stochastic functional integro-differential equation with infinite delays in a separable real Hilbert space and established the existence results. In [39], the existence of the mild solution nonlinear fractional stochastic differential equation has been studied by the authors by using fixed point theorems and α-resolvent family. For more study on stochastic differential equation, we refer to papers [8,9,15,35,36,38,39,44,45,33,32,37,34,21,29,43].