Nonlinear Analysis 74 (2011) 331–342

Contents lists available at ScienceDirect

Nonlinear Analysis

journal homepage: www.elsevier.com/locate/na

The existence and exponential stability of semilinear functional differential equations with random impulses under non-uniqueness

A. Anguraj [a,*], Shujin Wu [b], A. Vinodkumar [a]

[a] Department of Mathematics, PSG College of Arts and Science, Coimbatore-641 014, Tamil Nadu, India

[b] Department of Statistics and Actuarial Science, School of Finance and Statistics, East China Normal University, Shanghai 200241, China

ARTICLE INFO

Article history:
Received 20 February 2009
Accepted 7 July 2010

MSC:
35R12
60H99
35B40
34G20

Keywords:
Mild solutions
Semilinear differential equation
Random impulse
Existence
Exponential stability
Leray–Schauder alternative fixed point theorem

ABSTRACT

In this paper, the existence and exponential stability of mild solutions of semilinear differential equations with random impulses are studied under non-uniqueness in a real separable Hilbert space. The results are obtained by using the Leray–Schauder alternative fixed point theorem.

1. Introduction

Many evolution processes from fields such as physics, population dynamics, aeronautics, economics, telecommunications and engineering are characterized by the fact that they undergo an abrupt change of state at certain moments of time between intervals of continuous evolution. The durations of these changes are often negligible compared to the total duration of the process, since they act instantaneously in the form of impulses. It is now being recognized that the theory of impulsive differential equations is not only richer than the corresponding theory of differential equations but also represents a more natural framework for mathematical modeling of many real-world phenomena; see [1–5] and the references therein.

The impulses exist at fixed times or at random times, i.e., they are deterministic or random. Many papers have investigated the qualitative properties of fixed-type impulses; see [1–5] and the references therein. There are only a few papers that have studied random-type impulses. Wu and Meng [6] first introduced random impulsive ordinary differential equations and investigated the boundedness of solutions to these models by Liapunov's direct method in [6]. In [7], Wu and Duan discussed the oscillation, stability and boundedness of solutions to the model by comparing the solutions of this system with the corresponding non-impulsive differential system. In [8], Wu et al. discussed the existence and uniqueness in the mean square of solutions to certain random impulsive differential systems employing the Cauchy–Schwarz inequality, Lipschitz condition and techniques in stochastic analysis. In [9], Wu et al. first introduced random impulsive functional differential equations and considered the p-moment stability of solutions to these models using Liapunov's function coupled

* Corresponding author.
E-mail addresses: angurajpsg@yahoo.com (A. Anguraj), sjwu@stat.ecnu.edu.cn (S. Wu), vinod026@gmail.com (A. Vinodkumar).

0362-546X/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.na.2010.07.007