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Well-posedness and Dynamics of a Fractional Stochastic Integro-Differential Equation

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Abstract

In this paper we investigate the well-posedness and dynamics of a fractional stochastic integro-differential equation describing a reaction process depending on the temperature itself. Existence and uniqueness of solutions of the integro-differential equation is proved by the Lumer-Phillips theorem. Besides, under appropriate assumptions on the memory kernel and on the magnitude of the nonlinearity, the existence of random attractor is achieved by obtaining first some a priori estimates. Moreover, the random attractor is shown to have finite Hausdorff dimension.

Key words: fractional stochastic integro-differential equation; random attractor; Lumer-Phillips theorem; Hausdorff dimension; a priori estimates

AMS Subject Classification (2010): (2010): 35B40, 35R60, 37L55, 60H15.

1 Introduction

This paper focuses on the following fractional stochastic partial integro-differential equations, which is derived in the framework of the well-established theory of heat flows with memory (see [8]) on $\mathcal{O} \subset \mathbb{R}^3$, which is a bounded domain with smooth boundary $\partial\mathcal{O}$,

$$\frac{\partial u}{\partial t} + \beta(1-\gamma)(-\Delta)^{\alpha}u + \int_0^{\infty} \mu(s)(-\Delta)^{\alpha}u(t-s)ds + f(u) = k(x) + h(x)\frac{dW}{dt}, \quad x \in \mathcal{O},\ t > 0, \quad (1.1)$$

with boundary condition

$$u(x,t) = 0, \quad x \in \partial\mathcal{O}, \quad t > 0, \quad (1.2)$$

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