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ALMOST SURE CONVERGENCE AND STABILITY ANALYSIS OF HYBRID PARTIAL DIFFERENTIAL SYSTEMS UNDER JUMP MARKOVIAN PERTURBATIONS

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Abstract. In this work, the jump Markovian perturbations caused by the interactions among the states of a hybrid parabolic partial differential system are investigated in the context of vector Lyapunov functions and random partial differential inequalities. Sufficient conditions for almost-sure stability and convergence are developed utilizing a block comparison theorem. Moreover, an effort has been made to characterize the effects of Markovian random perturbations in stability of such systems. In fact, it has been shown that the Markovian random perturbations are indeed the stabilizing agents. In addition, an example is given to illustrate the significance of the presented results.

AMS (MOS) Subject classifications: 93E15, 93D20, 35K40.

1 Introduction

The mathematical modeling of several problems that arise in the fields of engineering, physical, and social sciences leads to distributed systems of partial differential equations. Since the introduction of the jump linear system(JLS) by Krasovskii and Lidiskii[5] in the early sixties there has been an increasing interest for this class of systems. It has been applied to model various dynamic systems, such as manufacturing systems, power systems, etc. For more information regarding the application of such systems, we refer the reader to Mariton[5], Sethis and Zhong[6] and the references therein. The jump parabolic differential systems is a hybrid system with state vector that has two components $u(t)$ and $\eta(t)$. Here $u(t)$ is referred to as the state and $\eta(t)$ is referred to as the mode. During the operation, the system can jump from one mode to another in a random way, which makes the class of systems a stochastic one. The switching between the modes is governed by a Markov process with discrete and finite statespace. When the system model is fixed it evolves like a deterministic nonlinear system. This kind of system can be used to discribe abrupt phenomena, such as component and interconnection failures. There is a vast literature available in this field, see Mariton[5], Anabtawi, Sathananthan and Ladde[2,3], and references therein.