

# Stability of switched stochastic nonlinear systems

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## 1. Introduction

Hybrid systems are digital real-time systems which are embedded in analog environment. Analog part of the hybrid system is described with differential equations and discrete part of the hybrid systems is an event driven dynamics which can be described using concept from discrete event systems (Cassandras & Lafortune, 2008) and (Tabuada, 2009). In this paper we will consider the switched systems which can be viewed as higher-level abstraction of hybrid systems (Liberzon, 2003) and (Sun & Ge, 2005). We model each subsystem of a switched system by differential equation.

There are two ways for analysis of stability of switched deterministic systems. The first one is a construction of common Lyapunov function. Find the common Lyapunov functions is a difficult task (Narendra & Balakrishnan, 1994). The second one utilizes multiple Lyapunov functions for analysis of switched systems (Branicky, 1998). In this paper we will consider a stability of switched stochastic systems. We assume that (i) there is no jump in the state at switching instants and (ii) there is no Zeno behaviour, i.e. there is finite number of switches on every bounded interval of time. The situation with jump in the state of  $x$  at the switching instants is considered in (Guan et. al., 2005) and (Li et al., 2005).

In recent years the stochastic hybrid systems become hot research topic. There are a few approaches to the problem. In the stochastic setting we have jump diffusion as the solution of stochastic differential equation driven by Levy process which is a linear combination of time, Brownian motion and pure jump process (Oksendal & Sulem, 2005). Close to deterministic hybrid systems is the concept of Piecewise deterministic Markov processes (Davis, 1993) and Stochastic hybrid systems (Hu et al., 2000). The most important difference among the models lies in where the randomness is introduced (Pola et al., 2001). Recently a few monographs are appeared which are devoted to Markov jump systems (Costa et al., 2005) and (Boukas, 2006). The monographs describe the processes that are subject to uncertain changes in their dynamics. Such kinds of systems can be described with Markov jump processes.

In this paper we will deal with stochastic stability of switched systems. Such problem for the systems in usual sense is covered in (Kozin, 1969), (Kushner, 1967) and (Hasminskii, 1980).

In the area of stochastic switched systems the important result is presented in (Chatterjee & Liberzon, 2004). In this paper is considered switched systems perturbed by a Wiener































