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ON STABILIZATION of HYBRID STOCHASTIC EQUATIONS

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Abstract. A stochastic hybrid (difference-differential) equation with control is considered in the form of a stochastic differential equation with respect to a semimartingale. This equation contains the stochastic Ito equation and the stochastic difference equation as the partial cases. The conditions on the control matrices and the coefficients of the equation which ensure stability of its trivial solution are obtained. The main technique employed in this paper is the method of the Lyapunov-Krasovskii functionals for the stochastic differential and difference equations, as well as some approaches from the theory of martingales.
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1 Introduction

Let probability spaces (Ω, F, P) with filtrations $F = \{\mathcal{F}_t\}_{t>0}$ and $F = \{\mathcal{F}_n\}_{n=1,2,...}$ be given. Let w_t be a 1-dimensional $\mathcal{F}_t$-measurable Wiener process and m_n be 1-dimensional $\mathcal{F}_n$-martingale. We assume $\xi_0 = 0$ and $\xi_n = m_n - m_{n-1}$ for $n \geq 1$. Then $\{\xi_n\}$ is 1-dimensional $\mathcal{F}_n$-martingale-difference (for details see [4]).

Suppose

$$a_t \text{ is a nonrandom step-function, right-continuous and having left-limits, } \Delta a_t = 1 \text{ for } t = n, n = 1, 2, \ldots, \; \Delta a_t = 0 \text{ for } t \neq n; \tag{1}$$

$$\mu_t \text{ is a pure discontinous } \mathcal{F}_t\text{-martingale such that } \Delta \mu_t = \xi_n, \text{ for } t = n, n = 1, 2, \ldots, \; \Delta \mu_t = 0 \text{ for } t \neq n. \tag{2}$$

We also define $(x)^0_{t-}(s) = x(s)$ for $s \in [0, t)$, and $[t] = \max\{i : i \leq t, i \text{ is an integer}\}$ for all $t > 0$.

The hybrid stochastic control equation containing continuous as well as discrete components can be interpreted as stochastic differential equations