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ON DELAY-DEPENDENT STABILITY FOR A CLASS OF NONLINEAR STOCHASTIC DELAY-DIFFERENCE EQUATIONS

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Abstract. Global asymptotic stability conditions for discrete nonlinear scalar stochastic systems with state delay are obtained based on the convergence theorem for semimartingale inequalities, without assuming the Lipschitz conditions for nonlinear drift functions. The Lyapunov-Krasovskii and degenerate functionals techniques are used. The derived stability conditions are directly expressed in terms of the system coefficients. The obtained results are compared to some previously known asymptotic stability conditions for discrete nonlinear stochastic systems. An illustrative example is given.

Keywords. discrete stochastic time-delay system, asymptotic stability, martingale convergence
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1 Introduction

The stability and stabilizabilty problems for time-delay systems have been extensively studied in recent years due to direct applicability of the obtained results to various technical problems [1, 4, 17]. Initiated in the background works [9, 10, 5], the stability theory for linear time-delay systems is now actively developed. The Lyapunov-Krasovskii or Lyapunov-Razumikhin functionals are applied in the framework of the Lyapunov direct method to prove the stability conditions for a selected class of linear time-delay systems. Two types of stability conditions can be obtained: delay-independent, establishing stability for all possible delay values, or delay-dependent, corresponding to some restricted values of delay shifts. While the first type of conditions is comprehensive but conservative, the second one is more selective, flexible, and, as a consequence, preferable. Some examples of delay-dependent stability conditions can be found in [7, 8, 16, 3, 2] for various deterministic linear time-delay systems and in [14, 12, 21, 22, 11] for stochastic ones. Note that it is frequently needed to make a special transformation of an original time-delay system to obtain such stability conditions. Nonetheless, virtually all known results involving delay-dependent stability conditions have been obtained for linear time-delay systems, with certain or even uncertain coefficients.

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