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STABILITY OF STOCHASTIC DISTRIBUTED PARAMETER LARGE-SCALE CONTROL SYSTEMS UNDER RANDOM STRUCTURAL PERTURBATIONS

G. S. Ladde

Department of Mathematics
The University of Texas at Arlington, Arlington, Texas 76019 USA

Abstract. By employing feedback control laws, the robust stochastic stability of distributed parameter large-scale control systems under random structural perturbations is investigated. The results are obtained by using vector Lyapunov-like functionals in the context of the block-comparison theorem, the theory of systems of differential inequalities, and decomposition-aggregation method. The complexity versus stability and stochastic versus stability issues are also studied. Examples are given to illustrate the usefulness of the results. The byproduct of this research has generated an open mathematical problem, namely, the boundary value problem for first order nonlinear partial matrix differential inequalities/equations.

AMS (MOS) subject classification: 60H10, 34D20, 93A15, 93E15 and 93E03

1 Introduction

In a number of applied problems about a system being studied is limited to output information. The method of stochastic approximation has proved to be a useful mathematical tool in the study of such systems. The main feature of this method is that it does not require the knowledge about the input of the system [10, 18, 20]. Only output information which is readily available for these systems, is required. In this work, stochastic approximation technique [12, 13] is used to investigate the stability of stochastic distributed parameter large-scale control system under random structural perturbations.

In Section 2, a brief outline about "A Guided Tour" [19] by Professor Siljak is presented. Section 3 deals with the problem description. In Section 4, we formulate a block comparison theorem in the context of distributed parameter systems under both internal and external random perturbations, vector Lyapunov functional, and systems of block differential inequalities. The presented theorem generalizes and extends comparison theorems in [3, 4, 5, 6, 7, 12, 13, 15, 18] in a natural way. By employing the comparison theorem of Section 4, Section 5 deals with sufficient conditions that assure stability properties of stochastic systems of partial differential equations of Ito-type under Markovian structural perturbations. The Results