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CONVERGENCE AND STABILITY OF STOCHASTIC HEREDITARY ITERATIVE PROCESSES

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Abstract: A new mathematical framework is proposed for convergence and stability analysis of stochastic hereditary iterative processes arising in applications of pseudogradient and other optimization algorithms. By employing the theory of difference inequalities, several comparison theorems in the context of vector Lyapunov-like functions are developed. These comparison theorems are applied to study various convergence and stability properties of the stochastic hereditary iterative processes. The most attractive aspects of this development is the fact that once the convergence of an iterative stochastic processes is established, estimates of the robustness and the convergence rate are almost automatic. Examples are given to demonstrate the obtained results. The method provides a tool to investigate the fundamental problem of stability versus delay effects.

AMS(MOS) subject classifications : 93E15, 34A11, 34K50, 34D20, 93D20.

1 INTRODUCTION

The stochastic delay iterative processes arises in a wide variety of optimization problems[4] involving regression equations and parameter estimation, adaptive systems and identification, and learning and image recognition and it is essential to establish the convergence and stability of iterative stochastic processes arising in applications of such problems associated with gradient and pseudogradient algorithms. Lyapunov's stability theory has been used [3,10,11] in establishing the convergence and stability of such problems associated with pseudogradient adaptation and training algorithms.
Comparison Principle [7,9] in the context of vector Lyapunov functions and differential inequalities have been developed and successfully utilized in the study of convergence and stability of deterministic systems of delay differential equations. This powerful technique has been extended [2,6] to systems