Asymptotic Methods for Stability Analysis of Markov Impulse Dynamical Systems

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Abstract: The paper deals with $n$-dimensional dynamical system of impulse type whose dynamical characteristics are dependent on the step Markov process with rapid switchings. The phase motion has small jumps at the moments of switchings and satisfies the ordinary differential equation in the intervals of constancy of the Markov process. The intensity of switchings, the quantities of jumps and the vector field of the differential equation are dependent on the phase coordinates and Markov process. Under some assumptions the limit averaged ordinary differential equation, the limit differential equation switched by the merged Markov process, the diffusion approximation and the limit stochastic differential equation of Ornstein-Uhlenbeck type for normalized deviations are constructed. It is proved that one can use the limit equations for stability analysis of an initial impulse dynamical system.

Keywords: Stability analysis; impulsive dynamical systems; Markov process.

Mathematics Subject Classification (2000): 34D20, 34A37, 34F05.

1 Introduction

The problem of asymptotic analysis of dynamical systems under small random perturbations has been discussed in many mathematical and engineering papers. Apparently, R.Z. Khasminsky was the first mathematician to have proved that the probabilistic limit theorems may be successfully used for differential equations with random right parts. The approach proposed in [12] makes it possible to apply for asymptotic analysis of real stochastic structural dynamical systems not only the Krylov-Bogolyubov averaging procedure but also diffusion approximation (see, for example, [6] and review there). It should be mentioned that in spite of the fact that the above result has been developed in [12] for

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