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ASYMPTOTIC STOCHASTIC ANALYSIS OF FAST OSCILLATING RETARDING DYNAMICAL SYSTEMS

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An asymptotic method for qualitative analysis of quasi-linear functional differential equations with small or rapidly oscillating perturbations dependent on phase coordinates and an ergodic Markov process is presented. The proposed method is based on an averaging procedure with respect to time and the invariant measure of the Markov process along the critical solutions of the linear equation. We have proposed an algorithm for dynamical analysis of the initial random equation with delay that permits approximate its solutions (which are stochastic processes) by corresponding solutions of a specially constructed averaged deterministic ordinary differential equation (called "fully simplified"). It is proved that for linear systems with small perturbations an exponential stability of the resulting fully simplified deterministic equation is suffice for exponential stochastic stability of the initial random system. Moreover, we have proved that problem of stability analysis of linear retarding dynamical systems with rapidly oscillating functionals one may reduce to stability analysis of deterministic linear functional differential equation applying an averaging procedure to above mentioned functionals.

To illustrate our proposed method we have considered the classical Marshall-Samuelson adaptive model of price dynamics, taking into consideration that an assertion about price increments dynamics is only rational expectation of market price reaction on supply and demand values and therefore equation reflects price dynamics in the mean. It should be mentioned that recent decades has appears many papers which intensively developed the branch of modern economics concerning the price dynamics analysis and elaboration of a rational algorithm of investor behavior under statistical uncertainty. It has been shown, that it is not enough to know smooth dynamical performances of financial flows, reached by moving-average procedure, but also is necessary to analyze extremely complicated and bad predictable chaotic price oscillations. This made many researchers use Ito stochastic calculus for modeling price dynamics. That is why our paper also deals with the stochastic analysis of price dynamics, writing an adaptive assertion in a form of stochastic Ito equation where shift is defined by demand and randomly delayed supply functions, and diffusion is proportional to price of stock with. That permits to take into account how value of risk has action upon the price dynamics.

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