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Comparison of a statistical simulation method and a spectral method for analysis of stochastic multistructure systems with distributed transitions

T. A. AVERINA* and K. A. RYBAKOV†

Abstract — Two methods for analysing stochastic control systems with distributed changes of structures are considered: statistical simulation and the spectral method. Algorithms for solving the problem are presented in the paper. The comparison of the methods and their efficiency are demonstrated on model problems.

Modern problems of controlling technical devices are described by mathematical models specified by various equations on random time intervals, i.e., models of *stochastic multistructure systems*. Stochastic multistructure systems are also called *systems with a random structure*. Such models allow one to take into account random factors, various regimes of functioning, abrupt external impacts, or possible failure of elements.

Some examples of systems with random structures are systems controlling approaching of aircrafts; systems for searching, holding, and tracking signals in navigation and aircraft flight control; combined targeting systems; as well as control systems with possible failures and malfunctions [7, 9].

Changes in a system structure may be caused by various reasons, such as a breakdown of one of the subsystems; an interrupted information input in the control contour; adaptation to environment; discontinuous disturbances being a result of natural or artificial external forces; exceeding the prescribed bound values for the coordinates of the state vector, etc.

Thus, systems with random structure are mathematical models for multimode stochastic systems of automatic control, which have a specific feature of jumpwise changes of their structure or some parameters at random time moments, i.e., change of the set of functional elements and relations between them.

An analytic solution to such systems may be found only in some exceptional cases. Therefore, the most common are approximate methods, which may be separated into two groups. The first group contains methods based on direct modelling of

*Institute of Computational Mathematics and Mathematical Geophysics, Siberian Branch of the Russian Academy of Sciences, Novosibirsk 630090, Russia

†Moscow Aviation Institute, Moscow 125993, Russia

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