

## Mathematical Model of Hierarchical Control of Reliability of the Spacecraft Onboard Systems with Changing Structure in Their Ground Testing

**V. A. Mironichev**, *v.mironichev@mail.ru*

*State Space Corporation «Roscosmos», Moscow, Russian Federation*

**M. I. Makarov**, *Dr. Sci. (Engineering), Professor, info@niiks.com*

*A. Maksimov Space Systems Research Institute — Branch of FSUE Khrunichev State Research and Production  
Space Center, Korolev, Moscow region, Russian Federation*

**V. B. Rudakov**, *Dr. Sci. (Engineering), Professor, info@niiks.com*

*A. Maksimov Space Systems Research Institute — Branch of FSUE Khrunichev State Research and Production  
Space Center, Korolev, Moscow region, Russian Federation*

**Abstract.** The paper offers a statistical approach to planning and monitoring the reliability of complex spacecraft (SC) systems with a changing structure in the process of their use. Such systems belong to the class of information and control systems and are characterized by deep redundancy, self-diagnosis of performance, and various kinds of automatic logical adjustments that ensure the fulfillment of assigned tasks. The approach is based on the structural-hierarchical principle, according to which, in order to confirm the specified reliability indicators of such systems, it is necessary to find such an interconnected set of statistical control plans for elements, subsystems, and the system as a whole, which would provide minimal economic losses due to the risks of making erroneous decisions, and the cost of control.

A mathematical model of a priori planning of optimal structural and hierarchical reliability control, the use of which allows, in the presence of the necessary initial data, to obtain optimal control plans for each level of the hierarchy, is proposed.

**Keywords:** control, reliability, optimization, planning, losses, risks of the first and second kind, structural hierarchy, structural and functional scheme of reliability, requirements, objective function, economic costs