SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts and Commercial Space Operations (2)

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CONTROL METHODOLOGY OF LARGE-SCALE SPACECRAFT GROUPS IN THE XXI CENTURY

Abstract

Receiving of scientific information and its dissemination in the close to real time scale is considerably an important task in the conditions of large-scale spacecraft orbit groups' expansion. At the same time the operating cost reduction of spacecrafts is becoming more significant. An important component of the strategy of groups' expansion in the XXI century is creation of a satellite space segment of spacecraft control. An effective task decision of rapid obtaining of object information and reduction of operation costs may be provided due to optimization of the structure, constitution and technologies of combined use of ground control equipment and space segments of spacecraft control. The methodology of spacecraft groups' control is presented in this work consisting of two stages. First using the matrix method of data conversion correspondences are set up between the needful requests for spacecraft control facilities use and existing possibilities of using these facilities. The matrixes of mismatch of given data and control facilities are determined, the problem issues of an existing situation are revealed. As a result alternatives for the use of controls are proposed including proposals on adjustment of given data. At the second stage on the basis of waiting theory the best of alternatives are determined by response speed of control tasks' decision with restriction to operating costs. For decision of optimal controls planning task state graphs are composed of task decision process. Probabilities of process occurring in each state Pi are determined by Kolmogorov's system of differential equations. For the given equation system the formal description of maximum principle can be used. The time minimum of system conversion from start to finite state can be used as an optimality criterion, i.e. time minimum for task solution. Thus, optimal control problem is reducing to determination of system's intensity of transitions between its states at the minimum time of finite state achievement. The suggested methodology allows to conceptually solve the problem of controls' optimal planning of perspective orbit group. At that not only the comparative assessment is realized of response rate of alternative variants but also critical components of the system are determined for every analyzed case.