

A. P. ALPATOV, Yu. M. HOLDSHTEIN

ON THE CHOICE OF AN OPTIMAL ON-ORBIT SERVICING ROUTE

*Institute of Technical Mechanics
of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine
15 Leshko-Popel St., Dnipro 49005, Ukraine; e-mail: aalpatov@ukr.net; jura_gold@meta.ua*

At present, the requirements for increasing spacecraft active life and operational reliability and reducing spacecraft operation costs become more and more stringent. A promising way to meet these requirements is to introduce on-orbit servicing, which allows one to solve engineering economic problems by performing service operations in space. On-orbit servicing involves a sequence of orbital maneuvering tasks under limited power capabilities of the service spacecraft. Because of this, of particular importance is the choice of an optimal on-orbit servicing route. The input data of this problem (the orbit parameters of the service spacecraft and the spacecraft to be serviced) are determined with an error. The orbit parameter determination accuracy is governed by the measurement accuracy, data handling method error, solar activity, density variations caused by solar activity, measurement time, and orbit parameter variations during orbital transfers. As a result, an advisable on-orbit servicing route is chosen under lack of information on input data. The aim of this paper is to develop a mathematical model for risk analysis in the choice of optimal on-orbit servicing routes under stochastic uncertainty in orbit parameters. The mathematical model developed is based on a statistical simulation of the traveling salesman problem. As a result of a statistical treatment of the mathematical simulation results, a discrete distribution of optimal on-orbit servicing routes was constructed. It is suggested that the maximum probability route be chosen as the optimal on-orbit servicing route. The stochastic model developed is illustrated by an example. The novelty of the paper lies in the development of a model for the choice of an optimal on-orbit servicing route under stochastic uncertainty in the orbit parameters of the service spacecraft and the spacecraft to be serviced. The results may be used in the justification, planning, and implementation of space service operations.

Keywords: *spacecraft, on-orbit servicing, optimal route, stochastic model of choice, traveling salesman problem, integer linear programming.*

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