
Development stage test-based software reliability indicator estimation for automated spacecraft flight control systems and mobile objects under surveillance

© A.G. Andreev¹, G.V. Kazakov¹, V.V. Koryanov²

¹Federal State Budgetary Institution 4th Central Research Institute of the Ministry of Defense of the Russian Federation, Korolev, Moscow region, 141091, Russia

²Bauman Moscow State Technical University, Moscow, 105055, Russia

The fact that errors may be present in the specialized software performing spacecraft flight data preparation by means of an automated control system for mobile objects under surveillance means that it is necessary to solve the problem of taking into account all types of tests that the specialized software is subjected to during its development and verification over the course of inter-department trials based on the customer's validation options. There exist two known methods of taking prior information into account that are used in the Bayesian approach to solving problems in statistics. The first one comprises a complete account of prior information obtained during software testing. The second one involves continuous accounting for prior information depending on whether it is of any value in obtaining a general estimation of the software reliability indicator. The study suggests a new method of accounting for prior information and obtaining a guaranteed non-overstated estimation of the software reliability indicator. The problem solution uses a Bayesian approach with regression accounting for prior information.

Keywords: hypothesis, control, spacecraft, reliability, data preparation, software.

REFERENCES

- [1] Morris W.T. *Management science: a Bayesian introduction*. Upper Saddle River, Prentice-Hall, 1968, 226 p. [In Russ.: Morris W.T. *Nauka ob upravlenii. Bayesovskiy podkhod*. Moscow, Mir Publ., 1971, 304 p.]
 - [2] Skripnik V.M., Grechin A.L. *Alternativnye ispytaniya malyykh vyborok na nadezhnost* [Alternative reliability testing of small samples]. Moscow, Nauka i Tekhnika Publ., 1986, 238 p.
 - [3] Sudakov R.S. and others. *Nadezhnost i kontrol kachestva — Reliability and quality control*, 1974, no.1, pp. 24–28.
 - [4] Teskin O. I. *Nadezhnost i kontrol kachestva — Reliability and quality control*, 1980, no. 4, pp. 9–17.
 - [5] Sudakov R. S., ed. *Statisticheskie zadachi obrabotki sistem i tablitsy dlya chislovykh raschetov pokazateley nadezhnosti* [Statistical problems of system processing and tables for numerical computations]. Moscow, Vysshaya Shkola Publ., 1975, 608 p.
 - [6] Feller W. *An Introduction to Probability Theory and Its Applications*. Vol. 1. Hoboken, John Wiley and Sons, 1964, 461 p. [In Russ.: Feller V. *Vvedenie v teoriyu veroyatnostey i ee prilozheniya*. In 2 vols. Vol. 1. Moscow, Mir Publ., 1984, 528 p.]
 - [7] Krinetskiy E.I. and others. *Letnye ispytaniya raket i kosmicheskikh apparatov* [Flight testing of rockets and spacecraft]. Moscow, Mashinostroenie Publ., 1979, 464 p.
 - [8] Kagan A.M., Linnik Yu.V., Rao S.R. *Kharakteristicheskie zadachi matematicheskoy statistiki* [Characteristic problems of mathematical statistics]. Moscow, Nauka Publ., 1972, 656 p.
-

-
- [9] Fedorovskiy A.A., Strogalev V.P., Vladykin E.N. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education: Scientific Journal*, 2015, no. 8. Available at: <http://technomag.bmstu.ru/doc/782796.html>.
- [10] Sidorin A.V., Romanova T.N. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education: Scientific Journal*, 2015, no. 8. Available at: <http://technomag.bmstu.ru/doc/793227.html>.
- [11] Anop M. F., Katueva Ya. V., Mikhailichuk V. I. *Nauka i obrazovanie: nauchnoe izdanie — Science and Education: Scientific Journal*, 2015, no. 1. Available at: <http://technomag.bmstu.ru/doc/755194.html>
- [12] Galaktionov V.S., Znak V.A., Znak N.E., Kazakov G.V., Kotyashev N.N., Sidorov A.V. *Strategicheskaya stabilnost — Strategic Stability*, 2009, no. 3, pp. 59–66.
- [13] Bordyukov M.M., Galaktionov V.S., Znak V.A., Znak N.E., Kazakov G.V., Sidorov A.V. *Dvoynye tekhnologii — Dual-Purpose Technologies*, 2009, no. 4, pp. 34–38.
- [14] Kazakov G.V., Znak V.A., Danilin S.B. Ob odnom podkhode k formirovaniyu ratsionalnogo mnozhestva testovykh variantov na osnove metoda faktornogo analiza [On one approach to forming a rational set of verification options based on the factor analysis method]. *Trudy MIT* [Proc. of Moscow Institute of Thermal Technology], 2015, vol. 15, no. 1, pp. 114–119.
- [15] Kazakov G.V. Metod otsenki pokazatelya nadezhnosti spetsialnogo programmnoho obespecheniya kompleksov sredstv podgotovki dannykh po rezul'tatam ispytaniy na etape razrabotki [Development stage test-based reliability indicator estimation method for specialised software of data preparation packages]. *Trudy MIT* [Proc. of Moscow Institute of Thermal Technology], 2015, vol. 15, no. 1, pp. 102–113.

Andreev A.G. (b. 1941), Cand. Sci. (Eng.), Senior Research Scientist, 1Federal State Budgetary Institution 4th Central Research Institute of the Ministry of Defense of the Russian Federation. Author of over 60 scientific publications in the fields of automated guidance system reliability. e-mail: kgv.64@mail.ru

Kazakov G.V. (b. 1964), Cand. Sci. (Eng.), Assoc. Professor, Head of Administration, 1Federal State Budgetary Institution 4th Central Research Institute of the Ministry of Defense of the Russian Federation. Author of over 50 scientific publications in the fields of automated guidance system reliability. e-mail: kgv.64@mail.ru

Koryanov V.V. (b. 1982) graduated from Bauman Moscow State Technical University in 2006. Cand. Sci. (Eng.), Assoc. Professor of the Department of Dynamics and Control of Rocket and Spacecraft Flight. Author of more than 20 works in the field of ballistics modelling and dynamics of spacecraft and descent vehicle motion. e-mail: vkoryanov@bmstu.ru
