MATHEMATICAL AND IMITATION MODELING OF SERIALLY SENSORS INERTIA

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Currently, development, production and implementation of sensors inertia and inertial systems left on a full industrial scale. In this regard, the most important task is to ensure a high reliability navigation for sensors inertia, stable operation at high of linear loads and varying temperature influences. Modern production of sensors can not be imagined without providing them a reliable quality assurance and testing throughout life cycle. The article discusses conduct observation parameters for the serially of sensors inertia such as sensors of angular velocity (SAV) and linear acceleration sensors (DLU). During tests should be performed and data registration processing as influencing factor, and parameters of object is testing.

Questions by testing of sensors inertia is devoted many books and articles. The book [1] is devoted to calibrating MEMS accelerometers based on the use of turn tables and vibrating stand. In the textbook [2] disclosed principles of testing of micromechanical devices.

Possible to automate the process of testing by use automated monitoring systems (AMS) by use to test simulation on computers. In this case, the mathematical model of the inertia sensor is checked on the computer using the software environment and allows you to even enhance the studies ability of sensors inertia in various modes, including critical and significantly reduce the time and subsequently testing.

To test the serial inertia sensor by simulation need to have the it dynamic mathematical model. Such model often have to develop independently, based only on the known structure of the sensor and the wiring diagrams (on base the part of published information products of developers). In this case it is necessary to obtain a mathematical model in the form of the transfer function. After then begin the verification of adequacy of transfer function the sensor inertia by simulation.

In particular, study of mathematical models of sensors inertia is dedicated to a number of articles [3, 4]. The article [3] produced the mathematical model MEMS of the sensor inertia and formulated requirements for its electromechanical parameters according to the criterion of static and dynamic accuracy. In [4] a mathematical model is made for micro angular velocity sensor works on the principle of micro gyroscope LL-type on corrective feedback.

The author of this article was conducted simulation computer tests for standard serial inertia sensor - accelerometer AT1104 by the manufacturer of ANPP "Temp-Air" Arzamas. This accelerometer by typical pendulum working on a compensation scheme was chosen in the catalog companie [5]. The mathematical model of the accelerometer, which the was compiled based on the known structure of the sensor and its electromechanical circuit partly published information products [6]. This mathematical model has been published by the author of this article in the international journal of applied and basic research [7]. Methodology and simulation results of the mathematical model were given in [8].

As discussed in [7, 8], problem statement of simulation was conducted in Matlab Simulink software, where visualized functional circuit AMS and test results. In the circuit simulation is carried out as a simulation equipment for creating input actions (angular velocity, linear acceleration, shock overload) and the sensor inertia by testing (in this case an accelerometer AT1104). Computer of the AMS is produced processing the sensor signals and calculates the controlled characteristics. Further development of research, initiated in [7, 8], is continue in inertia sensors to SAV and DLU used in highly maneuverable unmanned aerial vehicles.

Conclusions:

In preparing this article, produced the review of equipment for testing and calibration of accelerometers and gyroscopes. Spend analysis for serial of sensors inertia. Disclosed the techniques of testing sensors inertia on linear acceleration, vibration, shock overload. Is produced a simulation of tests the sensor on the example of the serial accelerometer AT-1104 . Is produced development of recommendations to optimize inertia sensors by the test.

References:

1. Kozlov D.P. Using the turntable and the vibrating stands for calibrating MEMS accelerometers. OJSC "Concern" Central Research Institute "Elektropribor". elektropribor.spb.ru/cnf/kmu2015/text/en06.doc
2. Evstifeev M.I., Stepanov O.A., Chelpanov I.B. Tests of micromechanical devices. Tutorial. - St. Petersburg: Publishing OJSC "Concern" Central Research Institute "Elektropribor". 2013 - 210 p.
3. Volkov V.L. Justification of requirements to parameters of a micromechanical accelerometer. // Proceedings of the NSTU n.a. R.Y. Alekseev - Nizhni Novgorod: 2011. № 2 (87), p. 288 - 295.
4. Volkov V.L., Khrisanova M.V. Maintenance of static and dynamic accuracy of MEMS angular velocity sensor. // Proceedings of the NSTU n.a. R.Y. Alekseev.- Nizhni Novgorod: 2013. № 2 (99), p. 329 - 338.
5. Sensors: Catalogue of ANPP "Temp-Avia". URL: http://www.temp-avia.ru/index-3.htm
6. Bilinkin S.F., Komarov N.A., Losev V.V. Accelerometers Series AT, develops and manufactures ANPP "Temp-Avia". / News of the Tula State University. Technical science. Issue 7, 2012, p. 305 - 321.
7. Volkov V.L., Karimov R.N. Mathematical modeling of the parameters of the monitoring system of serial inertia sensors. / -M .: Academy of Natural Sciences. "International Journal of Applied and Basic Research" in 2016, number 5, Part 3, p. 365-370.
8. Volkov V.L., Karimov R.N. Modeling of monitoring system for serial sensors. / -Penza: Article XVI VNTK. Aerospace equipment, high technology and innovations - 2015, Perm National Research Polytechnic Institute. 2015, p. 27 - 31.