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IN-FLIGHT CALIBRATION OF NANOSATELLITE'S INERTIA TENSOR: THE ALGORITHM AND REQUIREMENTS FOR ON-BOARD SENSORS

Abstract

For determination, prediction and control of nanosatellite angular motion, it is required to know its inertia moments with high accuracy. Usually the values of the nanosatellite's inertia moments are determined on the Earth during pre-start preparation. However, the inertia moments can change during the flight if there are transformable structures or a propulsion system that uses the working fluid on board of nanosatellite.

The task is to clarify the inertia moments of the nanosatellite during the flight on the basis of measurements of on-board sensors. In this case the problem of estimating the accuracy of the found values of the inertia moments of a nanosatellite is become very actual as in the most cases MEMS sensors are used for attitude determination and has noise.

The possibility of defining of nanosatellite inertia moments on the basis of indications of MEMS sensors is investigated, requirements for onboard nanosatellite measuring instruments are formed, which allows to estimate the inertia moments with the required accuracy. An effective algorithm has been developed that has a large range of convergence and is based on a numerical method of differential evolution. Testing the algorithm on model examples showed high stability and accuracy of the resulting solution. For a nanosatellite with a propulsion system, which uses a water – alcohol mixture as a working fluid, a study has been performed that allows choosing the measuring instruments with the required characteristics.

The proposed approach can be used in the implementation of missions involving the use of a nanosatellite as a means for a contact method for identifying dynamic characteristics and parameters of the movement of space debris before its capture and de-orbiting with a specialized spacecraft.