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METHODOLOGY OF IN-FLIGHT PARAMETER IDENTIFICATION FOR THE NANOSATELLITE ANGULAR MOTION MATHEMATICAL MODEL UNDER A PRIORI UNCERTAINTY

Abstract

In recent years, CubeSat format nanosatellites (NS) have established as a cheap, simple and operative instrument for space technologies implementation, which has a wide range of applicability. Therefore, today, NS are increasingly involved in solving modern problems of space exploration (providing global communications, inspection of space objects, remote sensing of the Earth, etc.). The space exploration requires the creation of low-orbit maneuvering NS formations. There are some requirements for NS as an element of formation such as the ability to perform orbital maneuvers, high autonomy, and a high-precision attitude control and determination system. Supporting the desired geometry of the formation requires the propulsion system on board the NS, which leads to a change mass and inertia moments of the NS in flight, that makes the nanosatellite a variable mass system. The main problems in implementing modern space missions using NS are the strong restrictions imposed by the CubeSat format. These restrictions include low power generation and a limited amount of space for the payload. To reduce these limitations, developers use various transformable structures onboard the NS (expanding solar panels, extendable rods with science equipment, etc.), so after launching into orbit, the design characteristics of the NS can be changed (moments of inertia, margin of static stability, etc.).) The problem of in-flight estimation of the NS design characteristics (mass, moments of inertia, margin of static stability) using measurements of on-board MEMS sensors is being solved. The paper formulates requirements for on-board sensors, which allows solving the problem with the necessary accuracy. The authors of this work created a method for identifying the parameters of an NS with a propulsion system on board (the results were reported at IAC 69). In this paper, the authors summarized the obtained results, created and tested a comprehensive methodology for the operational in flight identification of the parameters of the mathematical model of NS motion. The use of a numerical method of differential evolution is substantiated. This method allows obtaining stable solutions under conditions of a large degree of a priori uncertainty. The developed technique makes it possible to estimate the design characteristics of the nanosatellite with accuracy (less 3-5