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FEATURES OF THE USE OF MAGNETIC CONTROLS IN A COARSE STABILIZATION OF SPACECRAFT WITH AEROMAGNETIC DEORBIT SYSTEMS

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The development of hybrid deorbit means for used spacecraft is a promising line in the elaboration of space debris mitigation technologies. The main objective of this line is a search for optimal solutions in the development of new means for spacecraft removal from near-Earth orbits with account for certain operating limitations on the use of existing deorbit systems. So the advantage of hybrid deorbit means lies in broadening the scope of application of modern deorbit systems by combining certain technical features of each of them when developing a new system.

One of the lines in the development of hybrid means for space debris deorbit is the development of aeromagnetic deorbit systems for removing used spacecraft from low-Earth orbits. This class of systems features the possibility of controlled deorbit when using aerodynamic flat sailing elements. The control objective is the angular stabilization of a flat aerodynamic element perpendicular to the incident atmospheric flow. . Studies have shown that this stabilization of a flat sailing element increases the aerodynamic drag by 20–40 % and reduces the deorbit time by 25–30 % as compared to nonoriented deorbit, which broadens the scope of application of aerodynamic sailing deorbit systems. In aeromagnetic deorbit systems, the control actuators are magnetic attitude control systems (MACSs). The main criterion for the MACS effectiveness in a particular mission is a minimum of onboard power consumption. This may be achieved by using permanent-magnet actuators or spacecraft electromagnets (magnetorquers) in the rough stabilization mode. In its turn, in the rough stabilization mode the onboard power consumption is minimized when using time-shared control methods for the magnetorquers and a nonlinear discrete control law for the permanent-magnet actuators.

The aim of this paper is to develop methodological foundations for the use of permanent-magnet actuators and magnetorquers in the attitude control of used spacecraft with aeromagnetic deorbit systems. The paper makes an analytical comparison of the use of permanent-magnet actuators and magnetorquers depending on the spacecraft design features, mass, size, and energy characteristics and presents an algorithm of MACS choice for spacecraft of various classes equipped with aeromagnetic deorbit systems.

Keywords: *aeromagnetic deorbit system, magnetic attitude control systems, spacecraft, deorbit.*

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