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PROBABLE APPROACHES TO THE NEAR-EARTH ORBITS CLEAN-UP FROM SPACE DEBRIS WITH DIMENSIONS LESS THAN 10 CENTIMETERS

Abstract

Nowadays there are a lot of concepts aimed at large-dimensioned non-functioning objects removal from the near-Earth orbits which are at the different stages of design, working out and realization. As opposed to large-dimensioned space debris (upper-stages, rocket bodies, non-active satellites) small objects – such as picosatellites, satellites' fragments, pyrotechnic devices and other items less than 10 cm – can not be detected during trajectory measurements from the Earth due to the low sensitivity of space control means. This fact increases the threat of collisions with such objects because there is no any information about their orbital parameters. While solving the clean-up problem for this type of objects the authors assume that the removal satellite should be launched into the orbit predicted as the most mathematically probable for collision risks with small debris. This orbit is also understood to be the most probable for active (using a robotic arm) or passive (any kind of a trap) capture possibility. The satellites' constellation is arranged at the orbit which constitute the angle less than 90 degrees with the selected orbital plane. The elements of constellation are distributed along the orbit (different RAAN angle should be also investigated) to cover the target objects which have different value of argument of latitude. The capture construction (trap) in general represents a body of revolution with a huge surface area, opened either due to rotation process or due to pressurizing with following load-bearing elements curing. Catching and retention of small debris is carried out using the viscosity properties of structural materials (for mm-dimensions) and the constructions' geometry features (for cm-dimensions). Considered space system can be implemented as a constellation of typical satellites less than 1000 kg of mass, equipped with additional electrically powered propulsion for orbit maintenance and with main chemical propulsion for maneuvering with the aim of avoiding a collision with satellites and large-dimensioned space debris using the existent NORAD database.