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OPTIMIZATION OF SMALL SATELLITES SEPARATION CONDITIONS ENSURING THEIR UNIFORM DISPERSION AND LIMITATION IN APPROACH FURTHER

Abstract

The tendency in weights and dimensions reduction of near-space satellites and modern rockets performance capability increase make it possible to inject a considerable (increasing with time) number of satellites (for small and microsatellites up to several dozens and more) with one launch. Researches into satellite group dispersion after their separation and further approach at a small distance during long-term flight are of considerable interest. Basic physics of satellites motion in the earth's gravitational field defines their periodical approaches two times per orbit at satellites separation along normal to orbital velocity vector and much rarer at their separation in the flight direction. Ensuring of satellites required dispersion in the approach phase at minimum distance (with the tendency of increasing number of separated spacecrafts) runs into a significant difficulty due to require considerable separation velocities of first satellites. For example, in case their number equal to 30, minimum separation velocity of the first of them is about 5m/s with the separation step -0.15 m/s along the flight direction). At that, in three years minimum distances between the nearest satellites are several hundreds meters at nominal separation and flight conditions. Insertion of the satellites separation velocities along the mentioned directions simultaneously will simplify realization of their dispersion in flight. The paper presents studies into uniform dispersion of satellites in the initial phase after their separation and limitation in their approach further for two options of rocket 1 longitudinal axis orientation before spacecraft separation: transversely to orbital velocity vector Vorb with rocket roll turn through an angle ensuring the required conditions of satellites dispersion; in the flight direction with introduction of low longitudinal acceleration of rocket (at a level of 0.02m/s2) and approximately uniform spacing by time of separation of each satellite along normal to dispenser longitudinal axis. Studies are conducted at nominal separation and flight conditions of small satellite constellation with assessment of the influence of disturbing factors. The thruster afflux impact on satellites hardware was almost excepted for both scenarios. The paper offers optimal separation conditions of large constellation of small satellites to ensure their uniform dispersion in the initial phase of their autonomous flight, acceptable spacing at periodical approaches.