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ASSESSING MANEUVER PARAMETERS AND DETERMINING THE ORBIT OF OBJECTS IN GEO USING THE MINIMUM NUMBER OF OPTICAL OBSERVATIONS

Abstract

The results of this research significantly improve the speed and accuracy of maintaining the catalog of the most challenging objects in the geostationary orbit using optical observations. These objects are new ones or maneuverable, they also may have large and variable area-to-mass ratio. To solve the above-mentioned problems, the paper switches from the angles of right ascension and declination to radial, in-track and cross-track deviations with respect to the position of the object in the initial orbit at the moment of measurement. One "measurement" in this paper is the average value of the deviations obtained for one short tricklet consisting of several pairs of angles. Algorithms are developed to find the parameters of the maneuver performed by an active space object. To determine the parameters of a single maneuver (the moment of application and the value of the velocity impulse), which has only transversal or both the transversal and lateral components, one pair of angles of right ascension and declination is used. Two pairs of angles are required to evaluate the other maneuvers, including those performed by the low thrust engine. When two maneuvers have taken place between the last orbit determination and the first new measurement, or when a new object has appeared that needs to be cataloged, a new orbit must be determined, preferably by the minimum number of measurements. In this case, traditionally Laplace or Gauss methods are used, which require three pairs of right ascension and declination angles to determine the orbit. This paper proposes an extremely simple and reliable algorithm that uses only two pairs of angles to determine a previously unknown orbit. When predicting the motion of passive objects with large and variable A/m ratio, the perturbing acceleration is simulated assuming that it is constant in magnitude and direction over the time interval between measurements. The results of the calculations showed that the proposed methodology allows to determine parameters of the maneuvers with high accuracy. It means that if the found maneuver is applied to the initial known orbit, the new orbit matches very well with the current real orbit of the object.