An approximate projection of confidence ellipsoids of space objects positions onto the celestial sphere

A. P. Baturin

Research Institute of Applied Mathematics and Mechanics, Tomsk, Russia

The approximate method of calculation of a visible border of probable motion regions (PMR) for space objects (SO) has been considered. The PMR has been defined as a confidence ellipsoid in the phase space. A confidence ellipsoid is determined by LSM–estimations of motion–parameter vector $\hat{q}$ and its covariance matrix $\hat{D}$ (LSM is the least squares method). The considered method takes into account real dynamics of evolution of PMR, namely, the fact of expansion of the region mainly along the reference trajectory which is determined by the vector $\hat{q}$. Besides, the method includes several acceptable simplifications facilitating the construction of PMR visible border. As a result, the simple analytical expressions for border points of PMR projection onto the celestial sphere have been obtained.

The method has been tested by comparison of the obtained border with a projection of the set of points filling a confidence ellipsoid according to six–dimensional Gaussian distribution determined by the matrix $\hat{D}$. The algorithm for obtaining such set of points may be found in [1]. This technique gives the exact projection of PMR, so it has been used as a standard one. The asteroids Albert and Icarus have been chosen as models. For the calculation of LSM-estimations $\hat{q}$ and $\hat{D}$ the various samples of observations of these objects have been used.

The comparison of the proposed method with the standard one has shown that obtained border is of sufficiently good accuracy in all considered cases.

References

1. Pollak Y. G. Probability simulation on computers. M.: Soviet Radio, 1971, 400 (in Russian).