Paper ID: 78876
oral
student

21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations - 21st IAA SYMPOSIUM ON SPACE DEBRIS (IPB)

Author: Mr. Dmitrii Petrov
Moscow Institute of Physics and Technology (MIPT), Russian Federation, petrov.dmitrii.a@mipt.ru

Mr. Aleksandr Kuznetsov
Moscow Institute of Physics and Technology (MIPT), Russian Federation, kuznetsov.aa@mipt.ru
Mrs. Natalia Zavialova
Moscow Institute of Physics and Technology (MIPT), Russian Federation, zavialova.na@mipt.ru
Mr. Sergei Negodiaev
Moscow Institute of Physics and Technology, Russian Federation, negodiaev.ss@mipt.ru
Mr. Nikolay Chusovitin
Moscow Institute of Physics and Technology (MIPT), Russian Federation, chusovitin.nv@mipt.ru

ORBIT DETERMINATION WITH THE HELP OF SPACE-BASED OPTICAL INSTRUMENTATION IMAGES

Abstract

Nowadays there are tens of thousands of space debris objects in space. In most cases, the trajectories of these objects are determined by measurements generated by ground-based telescopes or radars. These methods of obtaining measurements have significant drawbacks. Ground-based opto-electronic equipment is mainly able to recognize only significantly distant objects, such as geostationary satellites, GPS satellites, etc. Ground-based radar facilities, on the contrary, are able to recognize objects with altitude not more than 3,000 km. For tracking space objects at other altitudes, it is possible to use space-based optical means. This paper shows that space-based optical means can contribute to the space monitoring system.

This study consists of three parts. In the first part, the authors simulated real images of tracks of space objects obtained by optical instruments. Space objects were taken by diffuse-reflecting spheres. When generating FITS files, the brightness of the observed object, its size and velocity were taken into account. In addition, the noise accumulated in the image was modeled.

The second part is devoted to the identification of tracks in the obtained noisy images. Based on the distribution density function of the noise electrons, it was possible to recognize signals whose values are smaller than the noise. In the last stage, coordinate information with time reference is obtained from the track.

The third part deals with the determination of orbits from the obtained measurements. For this purpose, the Kalman filter and the least squares method were used. In addition, the covariance matrix was calculated to estimate the errors in determining the obtained orbit.

As a result, we successfully simulated the work of a satellite with a telescope in the task of space monitoring and performed the determination of the orbits of space objects. Based on the obtained covariance matrices, we can assume that the described method of obtaining measurements can be used along with ground-based telescopes and radars.

The results of this work are useful for assessing the contribution of the space segment in the system of space monitoring as well as for modeling satellite constellations that solve the problem of monitoring near-Earth space.