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GEO AND MEO SPACE DEBRIS MODEL IMPROVEMENT BASED ON THE CATALOG OF KIAM RAS

Abstract

Unique capabilities provided by the GEO and MEO regions for solving the wide range of technical and scientific problems make them extremely important for space community. The number of resident space objects in these regions is growing steadily exacerbating the risk assessment problem for spacecraft operating in corresponding orbits. Further increase of reliability of the collision related estimates among other requires the improvement of space debris models associated with GEO, HEO and MEO.

Improvement of Russian space debris model "Space Debris Prediction and Analysis" (SDPA) on high orbits has been developed recently by joint cooperation of Keldysh Institute of Applied Mathematics (KIAM) and Federal State Unitary Enterprise Central Research Institute of Machine Building (TSNIIMASH). The model utilizes a statistical distribution in 4-dimensional space of key orbital parameters, which describe both shape of an orbit and orientation of its plane. The distribution itself is set by a Gaussian mixture model (GMM) to avoid inconvenient tabulation.

The KIAM orbital database provides information grounds for the space debris model. The database has been created in 2005 by the order of Russian Academy of Science for collection, storage and analysis of observational information obtained by the ISON network. By now the database has the most complete available information on the catalogued objects in GEO, MEO and HEO regions. For the last year the database has been updated with 22.7 million new observations covering almost 6000 objects on high orbits.

This work presents modeling results along with new methodology including initial clustering of the GMM, propagation of the distribution parameters in time with given scenarios and calculation of resulting collision assessment parameters.