

15th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Interactive Presentations (IP)

Author: Ms. Tatyana V. Labutkina
Dnepropetrovsk National University named after Oles' Gonchar, Ukraine

Prof. Vladimir O. Larin
Dnepropetrovsk National University, Ukraine
Mr. Vladimir Belikov
Dnepropetrovsk National University, Ukraine
Ms. Viktoria Serpokryl
Oles' Gonchar Dnipropetrovsk National University, Ukraine
Mr. Yaroslav Skoroden
Oles Honchar Dnipropetrovsk National University, Ukraine

IMPROVEMENT OF THE ACCURACY OF FAST METHODS FOR FORECASTING DANGEROUS
APPROACHES OF ORBITAL OBJECTS

Abstract

Currently, there are two approaches to prediction of mechanical conflict between orbital objects. The first is based on numerical simulation of orbital motion using detailed mathematical models and monitoring of the current distance between objects. The second is based on modeling and analysis of the trajectories and their current geometry. The methods of this approach are based on a quick prediction of intervals of simultaneous passing the segments of trajectories where objects may be dangerously close (dangerous segments). In these methods, mainly current geometry of orbits differing from Keplerian ones by only secular components is considered. Periodic changes of orbital parameters are only used for determining possible calculation error in the location of objects. Therefore, the accuracy of the methods of this approach is low. Numerical methods can be improved with auxiliary application (preliminary or parallel) of methods of the second approach to speed up calculations. This paper presents two methods, which are a development of the methods of the second approach for increasing their accuracy. The first method combines a simplified method (of the second approach), and a more accurate one of the first approach. The simplified method is only complemented by more detailed modeling of the simultaneous passage of the orbital objects through the dangerously close segments of their trajectories. The step of the simulation time is quite big (comparable to the orbital periods of the considered objects). Suppose that for some pairs of objects a simplified method identified intervals of their dangerous proximity (dangerous time intervals). A dangerous time interval of any of these pairs partially or wholly belongs to a time interval of a step. Before proceeding to the next step of time, for each of these pairs of objects, their motion is simulated with a sufficiently accurate mathematical model and control of the current distance between them. The described method includes a fast method of determining the initial positions of objects for the moment of the beginning of the detailed simulation of movement for dangerous segments of trajectories. In the second method, modeling of motion of orbital bodies and control of the current distance between them is not used. This method makes it possible to detect, for a pair of orbiting objects, dangerous segments of trajectories and intervals of simultaneous movement on them, taking into account not only the secular variations of the orbits, but also their periodic changes due to non-sphericity of the Earth.