Paper ID: 50145
oral

17th IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Post Mission Disposal and Space Debris Removal (1) (5)

Author: Prof. Vladimir S. Aslanov
Samara National Research University (Samara University), Russian Federation, aslanov_vs@mail.ru

CAPTURE OF DEBRIS IN GEO BY A HEAVY COLLECTOR AND TOWING IT TO GRAVEYARD ORBIT

Abstract

We propose an original method of removing small debris fragments from GEO, which is based on the nature of the libration motion in the three-body problem, similar in the Earth-Moon problem, when centrifugal inertia forces and Coriolis forces in the Earth-Moon system and gravitational forces from the Earth and the Moon act on a third small body. In our task, a heavy satellite as orbital collector located near GEO plays the role of the Moon. The scenario of the proposed method involves the implementation of three types of maneuvers: capture of the debris into the Hill sphere of the collector; towing of the debris located within the Hill sphere, together with the collector; dumping of the debris in graveyard orbit. The basic ideas of the proposed method were confirmed by numerical integration of the motion equation of the debris in polar coordinates relative to the collector.

To perform gravitational capture of space debris the heavy space collectors (10-100 tons) are required. However, the idea of building the heavy orbital collector does not seem more fantastic than building an Earth space elevator that will have a length of about 100 thousand km and a mass of more than 10 thousand tons. Moreover, in the future, the role of the heavy orbital collector can be performed by a relatively small asteroid delivered to GEO. In the near future, the proposed approach can hardly be applied to capture satellites with large solar batteries due to the relatively small radius of the Hill sphere. So if the collector's mass is 100 tons, then the radius of the Hill sphere is equal to 7.5 m. Apparently, the capture of small debris of destroyed satellites may well be realized already now. In this case, the reusable collector of space debris can be useful as a permanent "fire brigade" in GEO. Two different possible scenarios can be considered. In the first scenario, space debris is first captured in the area bounded by the Hill sphere, and when it hits the area near the collector, and the collector is carried out in a contact manner. The mass of the collector will increase and hence the radius of the Hill sphere will also increase with each absorption of space debris. This can be repeated many times. In the second scenario, space debris will remain within the Hill sphere and will not be captured to inside of the collector.