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DEBRIS SWEEPER IN HIGH ORBIT - DEBRIS BUMPER THAT DO NOT GENERATE EJECTA -

Abstract

Recently, many satellite constellations or large space structures such as solar power satellite have been proposed. Since they have a large total area, the number of collisions of small debris may also be large. Collision avoidance is essential because collisions between intact objects generate a large number of small debris, but environmental degradation and collisions of micro-debris/meteoroid also generate small debris or ejecta. At low altitudes, small debris is expected to re-enter relatively early, but at high altitudes such as geostationary orbit (GEO) and geostationary transfer orbit (GTO), it may remain in orbit for a long time due to the lack of atmospheric drag. It is also expected that debris smaller than 10 m will reenter due to the effect of solar radiation even in high altitude, but larger size of debris may accumulate. However, it is difficult to detect them from the ground and the detailed situation is not known. The collision probability for spacecraft in high altitude is considered to be low at present, but if the total area of spacecraft increases further, it may not be negligible. Therefore, a debris bumper for spacecraft at high altitude that does not generate ejecta is proposed for preserving the orbital environment. If the ejecta generation is prevented in case of collision with small debris, this debris bumper can be considered as a "debris sweeper", which can remove small debris from the orbital environment. For low altitude sweepers, a large number or a large area is required to collect meaningful small debris, while maneuvers to avoid collision with large debris is required and thus debris sweeper is not very cost effective. On the other hand, it is more efficient to remove large intact debris with high collision probability, which can be the source of the numerous small debris in case of collision. However, in the case of high altitude, even though the collision probability with large object is small enough, it is important not to generate ejecta or environmental degradation debris. In this paper, the collision direction, velocity, the expected number of collisions, and the amount of ejecta generated are evaluated for various orbits such as GEO and GTO. Then the structure of such bumper for large space structures is studied and environmental degradation and other issues to be considered will be discussed. Disposal methods and demonstration plans of such structures will also be investigated.