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Space carrying capacity assessment and allocation (10-E9.4)

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VERIFICATION OF CORRELATION BETWEEN A DEBRIS INDEX AND AN ORBITAL
ENVIRONMENT EVOLUTION AND CONSIDERATIONS OF A CAPACITY

Abstract

This paper aims to verify the correlation between the orbital evolution and a debris index and discuss the capacity. The rapid increase in the number of launch traffic due to the growing of space developments raises the possibility of environmental deterioration in orbit and concerns of overloading against a capacity. The deterioration could be generally rephrased as an increase in the number of objects that consequently causes the increase in collision probability or the number of conjunctions. Especially if plenty of non-operational objects are abandoned, the number of collisions with these objects would be raised. The new fragments will cause a rapid increase in the collision probability and the number of conjunctions with nearby operational satellites, immediately after a fragmentation. At higher altitudes, most of the fragments would remain in orbit which keeps the collision probability and the number of conjunctions higher for decades or hundreds. The growth of small debris that is un-trackable from the ground would also be a serious threat to an operational spacecraft. Since these environmental impacts would be changed due to the altitude or evolution period, this study organizes the objective and evaluated terms taking account a capacity. The debris index is an effective tool that can contribute to, for example, the selection of orbits with less environmental impact or the targets of active removal. To realize these objectives, the index should be able to assess how an object affects to environment and how long this risk will persist. The previous paper of this study proposed two processes that should be followed to establish an index. Since the previous study showed the tendency of the proposed index with few numerical simulations, this paper firstly verifies whether the proposed index can evaluate the impacts of fragmentation using a unified background environment, i.e., the mass, area of each object, and the number of objects in each altitude band are the same value. The sensitivity and correlation between the components of the index formula and the orbital environment evolution will be assessed through some numerical simulations using a debris environment evolutionary model. The total index of objects in an altitude band is compared with the trend in the number of objects or collision probability by changing the number of background objects, and the orbital capacity will be discussed. The current environment is also assessed with these above perspectives using the JAXA orbital objects database.