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ESTIMATION OF REMOVAL METHOD OF SPACE DEBRIS BY LASER ABLATION

Abstract

Currently, there are numerous space debris around the Earth. Space debris are artifacts orbiting around the Earth such as discarded satellites, rockets damaged by an accident and a failure, and small pieces generated by a collision. Observable debris from the ground whose size are larger than 10 cm exists more than 20,000. The number of debris whose size are smaller than 10 cm are estimated to be more than tens of millions. Those debris are difficult to be observed from the ground. Debris are moving at a very high speed of about 7 - 8 km/s. Even small debris hit the space shuttle or artificial satellite directly, there is a risk of serious damage. Actually, damages have also been reported. For this reason, research on avoidance method of satellite and debris removal method have been progressed. As one of them, removal method by laser ablation has been studied. Laser ablation is a phenomenon that the part of an object spurts out as plasma when it is irradiated with a strong laser beam. In this way, since it is possible to change the speed of an object, it is expected to be applied as a debris removal method. In the previous study, putting a satellite into orbit with an optical observation device and laser irradiation device, a system has been proposed that remove the debris observed from satellite by laser irradiation. However, debris removal effect is not considered in detail. It was done to only estimate the number of removable debris by calculation of the distance between satellite and debris.

In our study, we construct the orbit simulation of a satellite and debris considering observation and laser irradiation from the satellite. First, we investigated the size of debris can be observed by optical observation. We determined observability by calculating distance and relative speed of debris from a satellite. Second, we simulated orbit propagation of debris. As targets, we used Two-Line-Element data, FENGYUN 1C debris, IRIDIUM 33 debris and COSMOS 2251 debris published by North American Aerospace Defense Command. We investigated how the satellite approaches debris by setting some satellite orbits.

In future work, we simulate the removal effect of debris in more detail and show the effectiveness of our method more concretely.