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SPACE DEBRIS SYMPOSIUM (A6)
Space Debris Removal Issues (5)

Author: Dr. Beibei Wu
Beihang University, China

Dr. Chen Shenyan
Beihang University, China

PARKING ORBIT DESIGN AND OPTIMIZATION OF MULTIPLE TARGETS INTERCEPTOR PLATFORM FOR ACTIVE DEBRIS REMOVAL

Abstract

Orbital environment especially near-earth orbital debris environment created by space activities poses impact risks to human space flight and robotic missions. As satellites will continue to be launched and breakup events may occur again, the LEO debris population will increase even with a full implementation of commonly-adopted mitigation measures. To better preserve the near-Earth environment for future space generations, additional remediation measures such as active debris removal must be considered.

To implement active debris removal, spacecrafts which could approach objective debris should be deployed into proper orbit. Since researches showed that it would require removing about 5 objects per year to keep the future LEO environment stable, a platform with multiple interceptors is proposed to actively remove a given number debris larger than 10cm with single launch. The platform is assumed to be deployed in parking orbit. The interceptor loaded might be comprised of propulsion system, guidance and control system, and debris removal device such as net or absorber devices for debris capture. Once receiving the task command from the ground system, each interceptor will be released to perform orbital transfer and get close to target debris. Since the target debris are distributed in different spatial orbits, the parking orbit of the platform should make it possible for all interceptors to approach the target debris within their maneuver capability.

Aiming at this problem, the effective approach region was defined to represent the interception ability and a parking orbit design and optimization model was established. Multi-island genetic algorithm (MGA), which was developed based on traditional genetic algorithm (GA), was utilized to optimize the parking orbit parameters of the platform and the maneuver time of interceptors. The objective was to maximize the effective approach region while considering constraints of fuel consumption of interceptors and the number of debris intercepted. Above model and scheme were implemented for two test cases and reasonable results were obtained. The calculation results could provide technical basis for potential active debris removal solutions, which would reduce the probability of debris causing collisions and thus enable space activity to continue to increase more efficiently for all actors.