SPACE DEBRIS SYMPOSIUM (A6)
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COLLISION AVOIDANCE MANEUVER DURING THE SATELLITE CLOSEST APPROACHES

Abstract

Nowadays, the possibility of a satellite collision with orbital debris or another satellite because of the ever-growing number of space debris is becoming more probably. This event mostly poses a risk to space security and the space environment gradually is reaching a point in which collisions will be the main mechanism of debris generating in space. Today, this risk may be reduced by means of the appropriate avoidance maneuvering strategy. The factors affecting the decision of collision maneuvering are miss distance, collision probability, geometry, and orbits uncertainties. During the lifetime of a satellite, the evaluation of the number of imminent events and avoidance maneuvers requires the knowledge of the object propagation that can cause conjunction events. So, satellite orbit determination or satellite tracking is a way to predict or determine the accurate orbit and position of satellites and it is essential to find the closest approaches. Moreover, if the estimated probability of collision exceeds a safe threshold, the satellite collision avoidance will be a critical event. Determination of a suitable avoidance maneuver includes the estimation of a delta-V, one constraint and the cost function. This paper is to present a satellite collision avoidance strategy for a spacecraft in order to perform an appropriate maneuver to avoid collision with another spacecraft or space debris taking into account of propellant fuel reduction. As a case study, the possible collision avoidance maneuver of the controllable Irridium33 satellite to avoid colliding whit Russian nonoperational Cosmos2251 satellite is described. The mentioned satellites were orbiting at a high relative velocity in two intersected non-coplanar orbits. The first step is to analyze and determine the probability of satellite collision in order to understand the collision risk level. To do so, conjunction events have to be detected and this process is performed based on the TLEs and SGP4 propagation model to develop the crucial closest approaches. In this paper, a series of closest approach between Irridium33 satellite and Cosmos2251 satellite are reported. The best closest distance between the two satellites was predicted at about 1.6 km. Then using the predicted closest approach, the probability of collision between the two satellites is computed and finally base on the determined risk level, the possible collision avoidance maneuver is performed to move Irridium33 satellite away from Cosmos2251 satellite and put the spacecraft in a safe distance. After that, a compensation maneuver was also performed and the results are discussed.