SPACE DEBRIS SYMPOSIUM (A6)
Interactive Presentations (IP)

Author: Mr. Li Feng
School of Astronautics, Harbin Institute of Technology, China

Prof. zhang jinxiu
Harbin Institute of Technology, China
Prof. Xibin Cao
China
Mr. Xiaoyu Lang
Research Center of Satellite Technology, Harbin Institute of Technology, China

THE BOUNDARY ANALYSIS OF THE TLES' UNCERTAINTY IN ACTIVE REMOVAL OF CUBESAT-LEVEL SPACE DEBRIS

Abstract

Recent decade year, plenty of palm-sized cubesats are continuously launched into different orbits. Generally speaking, as secondary payloads, cubesats are deployed into roughly the same orbit with main payload. Due to most of Cubesats without deorbiter, if they are failure or out of work, they would become a member of space debris with small-size, similar with micro-segments from failure satellite or upper stage. It is becoming a serious problem that how to clean micro-segments, included failure cubesat and other minor space debris, to avoid the collision among spacecraft. We usually think that the determination of orbital position is the premise and base of effective debris removal in cleaning micro-segments. For much cubesat-level space debris without position modular, there are two optional methods to determine their absolute position in space, TLEs and ground-based observer network. The TLEs, updated periodically by NORAD, would be cheapest and more usable and accessible resource. TLEs are orbit position data with time stamped, that include neither error estimates nor any guarantee of their accuracy. In order to increase the tracking accuracy of micro-debris during long-distance homing, it is very necessary that effective analysis and trustable result for boundary of the TLEs' uncertainty. In paper, from the point of similarity principle in orbit, the TLEs of Swisscube(EPFL) and Shiyan-1(HIT) have been chosen as the raw data. Just because the Decimeter-Level orbit elements of Shiyan-1 satellite could be provided from high precision dual-frequency GPS receiver, it will be regarded as the baseline for TLEs' accuracy of cubesat-level space debris in order to find systematic rotational biases in the TLEs. Next, the public TLEs orbital data is transformed into osculating orbital elements by using SGP4 model. Then with the help of Kozai mean orbital theory, the osculating elements are converted into mean elements. And we will develop all-on-all conjunction analysis to the whole TLE catalog of two satellites. The preliminary results show that the TLEs' uncertainty is approximately 1 kilometers for cubesat-level space debris in the case of TLEs updated once a day. Further results will be detailedly discussed in full paper.