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SURVEY AND ORIGIN IDENTIFICATION OF BREAKUP DEBRIS USING TIME DELAY INTEGRATION METHOD

Abstract

The Geosynchronous Earth Orbit (GEO) is useful for infrastructures such as meteorological satellites and communication satellites. In this region, there are many fragmentation debris of which origins are unidentified. It is said that most of these debris were generated by breakups of spacecraft or upper stages. According to the past studies, two breakups have actually been confirmed in the GEO region. One is a US Titan 3C Transtage (International Designator (ID): 1968-081E), which was confirmed to break up in February 1992, and the other is Ekran-2 (ID: 1977-092A), which broke up in June 1978. In addition to these breakups, ten space objects are suspected to have broken up in the GEO region. The prehension of the current orbital debris environment is important for reliable risk assessments for safe and secure operation of infrastructures. Therefore, elucidating the environment of breakup fragments is necessary, and the origin of uncatalogued fragmentation debris should be one of the important clues. This paper proposes a strategy applicable for search and origin identification of fragmentation debris. This strategy uses ground-based optical telescopes and Charge Coupled Device (CCD) image sensors to search and detect fragmentation debris in the GEO region. This strategy also applies the Time Delay Integration (TDI) method. This method can detect moving faint objects such as asteroids by adjusting the rate of charge transfer in CCD sensor to the rate of the object motion on the image. This method needs known velocity of target object. Then, Kyushu University has established a method to predict the population and the motion of the debris generated by a breakup event. Thus, TDI method can be applied to the detection of faint debris. The TDI method selectively detects the fragments from the target breakup event. Therefore, once the target fragments are detected by using the TDI method, one can move onto the follow-up observation of the object immediately. Consequently, one can get its orbit precisely enough to identify the origin of the object. This paper verifies the proposed strategy through actual optical survey and origin identification of fragments generated by the confirmed breakup (1968-081E) at Bisei Spaceguard Center.