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IDENTIFYING ORIGIN OF BREAKUP EVENT BY IN-SITU MEASUREMENT

Abstract

Recently, the growth of space debris population is a difficult issue to be solved in terms of our space development for the future. Micron-size debris as well as space objects being tracked by the United States Space Surveillance Network are dangerous. In fact, micron-size debris impacts on spacecraft have been reported in the past. For these backgrounds, Kyushu University has initiated IDEA, the project for In-situ Debris Environmental Awareness to provide a prompt and clear understanding of the current micron-size debris environment. The IDEA projects aims to deploy a group of micro satellites conducting in-situ measurements of micron-size debris. IDEA-1 the first satellite for the project is currently under development at Kyushu University. The satellite has impact sensors, which can detect impacts with micron-size debris. The satellite can get location data of micron-size debris impacted. The objective of this study is to establish an estimation approach to identify an orbit on which a breakup event occurs using information from IDEA-1 on environmental change due to the breakup event. Previous studies have found that a probability of collision of IDEA-1 with micron-size debris from a breakup event is the highest on the line of intersection between the orbital plane of IDEA-1 and the orbital plane on which the breakup event occurs. Therefore, this study assumes that IDEA-1 gets impacted with micron-size debris data at the line of nodes. This paper uses the Chinese anti-satellite missile test to verify this estimation approach. First, a set of inclination and right ascension of the ascending node is selected as estimation parameters to determine an orbital plane. Second, an estimated equation is derived by formula of spherical trigonometry from geometric relation between the orbit of IDEA-1 and an orbit of breakup event. Finally, a non-linear least squares method is applied for the estimated calculation to find values of the estimation parameters. Results from this study confirm that using in-situ measurements can identify the orbital plane on which the Chinese anti-satellite missile test was conducted. This study continues to estimate an orbital plane on which another breakup event occurs and will erect the estimated method of orbital planes in order to identify orbits in the future. If the method of identifying the origin of breakup events is introduced, we can minimize the damages to operational spacecraft, which caused by space debris of every size derived from breakup events after launches of measurement satellites.