SPACE DEBRIS SYMPOSIUM (A6)
Measurements (1)

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OBSERVATION TECHNIQUES MADE THROUGH THE KAMISAIBARA RADAR

Abstract

Japan Aerospace Exploration Agency (JAXA) has observed space debris by a small phased-array radar, the Kamisaibara Radar owned by Japan Space Forum, since 2004. The observation targets are publically released objects observed by U.S. Space Surveillance Network (SSN). The purpose to utilize this radar is in order to obtain more accurate orbital information of space objects for reentry predictions and for conjunction assessment to our satellites.

The radar usually refers the SSN Two-Line Elements (TLEs) or self-determined orbital information for initial acquisitions. However, the reentry objects are sensitive to the prediction errors of atmospheric density and these errors reduce the prediction accuracy. When JAXA started observation, it was a task that our success rate to track reentry objects was low. In recent years, we established a method called the Multi-Stage Observation (MSO) and made much progress in observing the objects in the last hours of reentry as long as they are physically visible.

Since the radar is operated automatically from initial acquisitions to tracking, the prediction errors are allowed only within about +/- 20 seconds as the restrictions came from the auto-tracking algorithm. Whereas, our past results show the reentry objects sometimes have the prediction errors more than 20 seconds even when we applied fresh TLEs for acquisitions. The MSO is such a method that we give multiple predictions considering large prediction errors for one reentry object. By making full use of this phased-array radar, which can track up to 10 objects simultaneously, we absorb the prediction errors larger than 20 seconds.

On the other hand, regarding the observation in Low Earth Orbit (LEO) at the altitude from 400km to 700km, we could increase substantially the number of catalogued objects, whose orbits are determined by our own, in recent years. In 2007, as a result of the observation for 16 hours a day, we determined approximately 110 catalogued objects per month. We examined the range where the radar transited to auto-tracking for regularly observed targets and tuned the range settings for initial acquisitions. By this evaluation, we succeeded in increasing the number of catalogued objects to ca. 240 per month in the same observation period in 2009.

In this paper, we introduce the MSO method and also the way how we tuned the range settings for initial acquisitions to exploit the highest capability of the radar, by showing the results through the 6-year observation with the Kamisaibara radar.