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ORBIT DESIGN AND ANALYSIS OF ARTIFICIAL METEORS GENERATING MICRO-SATELLITES

Abstract

The Space Robotics Laboratory of Tohoku University and ALE Co., Ltd. have jointly developed the micro-satellites “ALE-1” and “ALE-2” to demonstrate the generation of artificial meteors. The ALE-1 was launched from Uchinoura Space Center in Japan on January 18, 2019, and the ALE-2 was launched from Rocket Lab from Mahia, New Zealand on December 6, 2019. ALE-1 was injected into a sun-synchronous orbit with an altitude of 500 km and LTDN 8:00, and ALE-2 was injected into a sun-synchronous orbit with an altitude of 400 km and LTDN 20:00.

The mission of the ALE satellites is to produce artificial meteor showers by releasing artificial meteor particles from the orbit and to provide them as a commercial service for entertainment events. In addition, by observing the orbit and emission characteristics of artificial meteor particles as they re-enter the atmosphere, the ALE satellite aims to investigate the composition and orbital mass distribution of meteorites and to understand the characteristics of the Earth’s upper atmosphere.

The ALE satellite carries hundreds of meteor particles to generate artificial meteors. When generating an artificial meteor, the particles are ejected in the opposite to moving direction of the satellite, which causes the particles to lower the orbit of the satellite and re-enter the atmosphere as an artificial meteor.

In order to generate an artificial meteor, the observation point must be at night, and the meteor must be observable at any point in the world, including at sea. In addition, to prevent the ejected meteor particle from colliding with other satellites or spacecrafts, the possibility of collision is analyzed in advance. However, for the ISS, which is manned by resident astronauts, it is necessary to ensure stricter safety. Therefore, the spacecraft will orbit at an altitude of 400 km, which is a lower orbital altitude than the ISS, to ensure safety. Based on the above, we decided to conduct the mission in a sun-synchronous orbit with an altitude of 400 km LTDN 8:00 or 20:00.

In this paper, the usefulness of the sun-synchronous orbit is shown by comparing the orbits for the satellite to generate artificial meteors by simulation.