SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Small Launchers: Concepts and Operations (7)

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TRAJECTORY DESIGN OF SOUNDING ROCKET BASED NANO LAUNCHER

Abstract

On January 2017, JAXA/ISAS launched the Nano launcher based on the sounding rocket. Unfortunately, the rocket was not able to put a satellite into orbit. But this paper discusses about the trajectory design on how to manage the sounding rocket into a satellite launching vehicle In JAXA/ISAS, there are three types of sounding rocket. Two of them are the single stage rocket called S-310, S-520 and one of them is two stage rocket called SS-520. These sounding rockets have tail fins for spin stabilization, but usually don't have an attitude control system during the flight. If the attitude control is required to achieve the mission requirement, there is a gas jet system as the optional device. The gas jet system can control the spin axis direction and the spin rate of the vehicle during the coasting fight. To make the sounding rocket put a satellite into orbit, the third stage motor is added into the two-stage sounding rocket SS-520. The gas jet system is the unique active attitude control system and installed into between the first stage and the second stage of the vehicle. Because of this constraint, the apogee altitude after the burn out of the first stage motor almost correspond with the perigee altitude of the elliptical orbit. In this mission, the sounding rocket based Nano launcher is planned to put 3U sized cube sat into the elliptical orbit. Its targeted apogee altitude is about 1,800 km and its perigee altitude is about 180 km. Because the perigee altitude is relatively low altitude, the orbit life is very short. The vehicle error or the environment error deeply affect the achieved trajectory. These errors must be small enough to put a cube sat into orbit. This paper also discusses about the effect of the orbital distribution depending on the various errors.