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A CONCEPTUAL STUDY OF KICKSTAGE AND DUAL LAUNCH SCHEME FOR MISSION EXPANSION OF KOREAN SMALLSAT-DEDICATED LAUNCH VEHICLE

Abstract

Through the development of the Nuri, the Republic of Korea secured launch vehicle manufacturing technology and infrastructure such as manufacturing facilities, test facilities and launch sites. And the development of a Smallsat-dedicated launch vehicle(SLV) to respond to the rapidly increasing launch demand for small satellites by utilizing those technology and infrastructure was included in Korea's 3rd Basic Plan for Space Development Promotion. For this, the KARI For this, the KARI have started prior research on a SLV that can put 500 kg payload into 500 km SSO. The development of low-cost fuselage and engine manufacturing technology for securing competitiveness in the launch service market are included in this research. A SLV has the advantage of being able to have a shorter launch cycle and a lower launch cost compared to larger launch vehicles. Based on these advantages, the SLVs currently in operation or under development are being attempted to be used for space exploration missions by adapting a kickstage. The SLV being developed by KARI also aims to reduce the cost and have a shorter launch cycle, and research is also underway to maximize the utility of the SLV by adding a kickstage like other SLVs. First, a conceptual study of a kickstage that can transport a payload weighing several tens of kilograms in lunar orbit to perform Pathfinder missions before main exploration missions, or perform in-orbit demonstration missions required for satellite payload development has been conducted. The trajectory and the required velocity increment of the kickstage were derived through the mission design, and the required propellant mass was also estimated based on the assumed performance of the propulsion system. After distributing the mass to each subsystem and deriving the requirements, an initial conceptual design of the kickstage was performed. The designed kickstage was expected to be capable of transporting about 30 kg of payload to a frozen orbit of the moon at an altitude of 100 km. Next, using the fast launch cycle of a SLV, the concept which two kickstages were launched one after the other and docked in low earth orbit was proposed for maximizing the performance in space exploration missions. A mission design including a docking process was carried out with the goal of lunar exploration, and as a result of the mission design, it was expected that about 150 kg of payload could be transported to low lunar orbit.