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A STUDY ON METHODS TO OVERCOME GEOPOLITICAL CONDITIONS FOR THE DEVELOPMENT OF KOREAN TWO-STAGE REUSABLE LAUNCH VEHICLE

Abstract

Recently, in the launch service market, the paradigm is changing from the development of a performance-oriented launch vehicle (LV) to the development of a cost-oriented LV that lowers the launch cost through the reuse. In accordance with this trend, plans to develop the reusable LV are being discussed in Korea, and related basic research is being started. Although the Nuri was developed as a three-stage LV, it is considered that it is reasonable to choose a method of returning the first stage by composing the reusable LV in a two-stage type regardless of its performance. In the two-stage reusable LV, the lower the velocity at the separation of the first stage, the more advantageous it is to return the first stage. However, in this case, a relatively large second stage is required to input the payload into the target orbit. Since the weight increase of the second stage causes an increase in the weight of the first stage, as a result, the overall LV size increases. Hence, these points should be considered when designing a two-stage reusable LV. Assuming the development of a Korean reusable LV, referring to the flight data of Falcon 9, the staging of the LV and its mission design was conducted. In the case of Falcon 9, the first stage is separated at a velocity of about 1.5 – 2 km/s. When this is applied to the Korean LV in the same way, there is a problem in that a drop point is formed in Japanese waters during expendable mission. Therefore, the size ratio of the first stage and second stage should be larger compared to the Falcon 9, and in this case, the first stage return becomes disadvantageous as described above. In order to overcome these limitations in the development of Korean two-stage reusable LV, a method for forming a father drop point by burning residual propellant at expendable mode operation was proposed. The distribution of the drop points according to the amount of residual propellant and the payload injection performance of the LV were evaluated. In addition, a study was conducted on how to reduce the distribution area of the drop point and the optimal drop point was derived in terms of flight safety. Based on these results, we plan to conduct a basic design for an optimal Korean reusable LV in the future.