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STUDY ON LIFT AND DRAG CHARACTERISTICS OF RETRO-PROPULSION STAGE OF REUSABLE ROCKETS

Abstract

Vertical recycling is currently the primary method used in partially reusable launch vehicles. In this paper, numerical simulations are conducted to study the lift and drag characteristics of the retro-propulsion stage of a single-nozzle configuration launch vehicle. The simulations are carried out using the RANS method for various typical flight conditions in the Mach number range of 4-6 and flight altitude range of 30 km-50 km. The lift and drag characteristics of the flow reattachment zone and the vehicle body under different flight conditions are obtained. The research results show that the presence of opposing jet flow produces a low Mach number area around the vehicle body, which forms a shielding effect and affects the lift and drag characteristics of the vehicle. The lift and drag characteristics are greatly influenced by the flight altitude when the jet flow exist. This characteristics is exactly opposite to the trend observed when there is no jet flow. During the high-altitude stage, the shielding and injection effects of the reverse jet flow significantly reduce the drag of the bottom of the vehicle body, and even produce negative drag in some flight conditions. It is proposed that the ratio of the opposing jet to the width of the vehicle body can be used as an aerodynamic characteristic parameter to better characterize the aerodynamic characteristics of the vehicle under the influence of the opposing jet.