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EXPERIMENTAL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF THE REUSABLE LAUNCH VEHICLE IN VERTICAL LANDING

Abstract

Vertical landing is one of the key technologies of a reusable launch vehicle (RLV), which is supposed to be the low-cost and frequent space transportation system in the future. During the vertical landing phase, a vehicle is required to decelerate enough for the soft landing and to keep its attitude vertical. Deceleration and attitude control are expected to be achieved by retro propulsion and thrust vectoring. In retro propulsive flight, it is known that the interference of the free stream and the exhaust plume affects the aerodynamic characteristics of the vehicle. Force and moment acting on the vehicle cannot be expressed as the sum of those caused by the thrust and aerodynamic characteristics without retro propulsion. To clarify the aerodynamic characteristics with retro propulsion is necessary to evaluate the vertical landing of an RLV. Although many studies about retro propulsion have been made, few force and moment measurements were dealt because of the problem of exhaust gas supply. In progress studies, the gas was supplied from outside of the test model. Gas supply tube or pipe can interfere the measurement, but the effect of the gas supply was difficult to estimate. For more precise understanding of the aerodynamic characteristics with retro propulsion, the experimental setup without external gas supply is required. In this research, aerodynamic characteristic of an RLV with retro propulsion will be made in the wind tunnel test. Retro propulsion will be realized by equipping small gas tanks inside the test model so that gas supply does not affects the measurement. Experimental conditions are chosen to rebuild the vertical landing of Japanese experimental RLV, RV-X. Aerodynamic characteristics will be evaluated from the force and moment measurement by the internal balance and surface pressure measurement. Interference of the free stream and the exhaust plume will be discussed by the flow visualization and pressure measurement. The outcome of this research contributes to design the vertical landing maneuver of an RLV and deepens the understandings of retro propulsion phenomena.