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Author: Dr. Takayuki Yamamoto
Japan Aerospace Exploration Agency (JAXA), Japan, yamamoto@isas.jaxa.jp

Mr. Takushi Sakamoto
The University of TOKYO, Graduate school, Japan, sakamoto.takushi@gmail.com
Dr. Satoshi Nonaka
Japan Aerospace Exploration Agency (JAXA), Japan, nonaka.satoshi@jaxa.jp
Prof. Yoshifumi Inatani
Japan Aerospace Exploration Agency (JAXA), Japan, inatani.yoshifumi@jaxa.jp

NOSE FIRST ENTRY FLIGHT AND TURNOVER MANEUVER FOR LANDING FOR SMALL-SIZED DEMONSTRATION VEHICLE OF REUSABLE SOUNDING ROCKET

Abstract

In ISAS/JAXA, a fully reusable sounding rocket is proposed as one step for the future full-fledged reusable transportation system. This vehicle is a vertical take-off and vertical landing (VTVL) rocket vehicle. And this has the capability of ballistic flight to the altitude over 120 km and returning to the launch site. In the flight sequence, the vehicle takes off vertically and cuts main engine off about 100 seconds later, and reaches to an altitude about 120 km during the ballistic flight. After that, the vehicle turns back into a nose first attitude. During the return flight, the vehicle is guided to above the launch place. Then the vehicle makes a turnover maneuver to base first attitude from a nose first entry attitude. This makes it possible to achieve the deceleration and soft landing by its main engine thrust. It is considered that there are many technical concerns to realize this vehicle. One of the technical concerns is a turnover maneuver during the return flight. As for the turnover maneuver, it is considered for applying the aerodynamic turnover maneuver which is caused by the differences of pitching moment depending on the vehicle configurations. In past years, several vehicle shapes and aerodynamic devices were investigated as for the trim stability during reentry flight and the feasibility of inversion maneuver. To verify the turnover maneuver capability, it is considered to demonstrate the glide tests using the small sized vehicle model. In this demonstration, the technical problems for the turnover maneuver as for the vehicle dynamics and guidance control strategy will be investigated. In this paper, the feasibility study of nose first entry flight and the turnover maneuver for landing is numerically investigated. It is shown the turnover maneuver capability depend on the range of center of gravity. And it is also shown the control strategy of aerodynamic devices.