SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Upper Stages, Space Transfer, Entry and Landing Systems (3)

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

Dr. Satoshi Nonaka
Japan Aerospace Exploration Agency (JAXA), Japan, nonaka.satoshi@jaxa.jp
Dr. Takashi Ito
Japan Aerospace Exploration Agency (JAXA), Japan, ito.takashi@jaxa.jp
Dr. Yusuke Maru
Japan Aerospace Exploration Agency (JAXA), ISAS, Japan, maru.yusuke@jaxa.jp

REENTRY GUIDANCE AND TURNOVER DYNAMICS FOR SMALL-SIZED 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. To show the feasibility of the vehicle, technical demonstrations are under way in JAXA. One of the technical concerns is a turnover maneuver during the return flight. As for the inversion maneuver, it is considered for applying the aerodynamic turnover maneuver which is caused by the differences of pitching moment depending on the vehicle configurations. For example, vehicle configurations are changed by deploying strake, a kind of canard. 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 turnover maneuver control for the nose first entry of the small sized vehicle is numerically simulated and the return flight guidance to a point is proposed. And turnover maneuver dynamics of the vehicle is investigated for practical use. The guidance and control method proposed here would be applied for the full scale reusable sounding rocket vehicle.