IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Technologies for Future Space Transportation Systems (5)

Author: Dr. Satoshi Nonaka
Japan Aerospace Exploration Agency (JAXA), Japan

Dr. Takashi Ito
Japan Aerospace Exploration Agency (JAXA), ISAS, Japan
Prof. Yoshifumi Inatani
Japan Aerospace Exploration Agency (JAXA), Japan

PRESENT STATUS OF SYSTEM VERIFICATION STUDY BY REUSABLE VEHICLE EXPERIMENT

Abstract

From the results of the technical maturation studies for the reusable sounding rocket from 2010 to 2016 in ISAS/JAXA, most of the technical issues identified for development of an operation system have been demonstrated. Reusable engine development and its test result satisfied the required performance and operability for reusable system. Moreover, various new findings have been identified for the next phase. Therefore, we are technically ready for the next phase for a reusable rocket system development. Under such status of technical readiness for development of reusable system, we proposed an activity by a flight demonstrator RV-X making use of the repeated flight environment and to stimulate the next promotion for RLVs. Study objectives of this activity are 1) system architecture study for repeated flight operations, to demonstrate quick turnaround operations, inspection between flights, maintenance planning, damage / failure tolerant design method to greatly reduce the loss-of-vehicle probability, 2) life controlled and frequently repeated use of cryogenic propulsion system and its flight demonstrations, 3) guidance and control study for the advanced returning flight method of vertical landers and its flight demonstrations, and 4) demonstration of advanced technology for future RLVs. Design and development of RV-X vehicle is in progress now by maximum use of existing components and technical outcomes obtained from ISAS RLV related studies. Two flight campaigns are planned in this flight demonstration study. In the first flight test campaign, we will demonstrate pump fed and deep throttling engine, gimbaling attitude control for vertical landing by lift-off and landing with powered flight, a quick turnaround operation and so on. And in second flight campaign, we will demonstrate returning flight and landing by engine cut-off and re-ignition. In this second flight test campaign, advanced technical items such as aerodynamic control, propellant management, composite cryogenic elements will be also demonstrated. To pursue optimal returning flight and landing, some flight profiles are considered and will be tried to demonstrate technical issues related returning flight. For returning flight and landing of reusable first stage, we will demonstrate continuous throttling capability, guidance and control for pinpoint landing, landing area safety by flight profile like this. Moreover, to minimize the propellant requirements for landing, a flight profile with nose-first entry and turnover maneuver will be also demonstrated. In this paper, present status of preparations for RV-X flight demonstrations are presented.