

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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INVESTIGATIONS ON FLIGHT CONTROL FOR ROCKET FIRST STAGE RECOVERY

Abstract

Re-usability of a rocket first stage implies some major technical challenges in order to be able to bring the vehicle back and ensure its capability to re-fly another mission. CNES Launchers Directorate has been looking at this topic with a renewed interest, with the objective to identify the most critical aspects of such a scenario and address them through engineering studies and when relevant through technological demonstration. This paper focuses on flight control and its implications throughout various options that could allow to recover a rocket first stage to the launch site. First, an overview of stage return scenarios studied at CNES Launchers directorate is presented, which includes return modes using only main propulsion, only aerodynamics, or hybrid solutions mixing those two approaches. Emphasis is put on high level characteristics of each trajectories and corresponding vehicles, and an analysis of flight control aspects of each flight phase is proposed, pointing out their specificity with respect to the conventional case of an expendable launch vehicle. Then, results of dedicated flight control design studies are presented, that on one side aim at defining requirements toward attitude control system and on the other side contribute to the overall trade-off on stage recovery modes. Based on these analyses, opportunities associated to an in-flight demonstration are outlined.