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

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REUSABLE ROCKET STAGE EXPERIMENTAL VEHICLE AND DEMONSTRATION

Abstract

The launch vehicles competition is more and more focused on dedicated launch service and launch cost reduction. The latter can be obtained by different means and approaches, such as industrial set-up, technology, industrial process and possibly reusability of booster stage or booster propulsion bay. The interest of reusability is strongly dependent on the launch manifest and versions of the launcher used to face the launch manifest. It is also dependent on the propellant choice, via the engine and stage simplicity, and launch/maintenance operations. CNES/DLA is investigating the way to reduce launch system cost through market adaptation in both expendable and partially reusable launch vehicle options, as well as on the implementation of propellants like liquid oxygen / methane on future generation launch systems. The essential brick for this economy model consists in the most suitable strategy for reusing the booster stage, eventually through a mixing of reusable and expendable items. In order to cope with reusability the related mission critical areas need to be proven and disruptive technologies prepared. In this respect, in-flight system experimentation/demonstration enables to validate not only the key technologies, but also their integration into the system in representative environment, as well as the complete system functional aspects. This permits to significantly reduce the risk of failure for the operational launch system and permit to verify the entire vehicle refurbishment phase, which is considered as a key driver for reusable launchers effectiveness. The objective of the experimentation/demonstration is to link technology performances to operational capability in order to validate the concepts, confirm the cost model hypotheses, and facilitate identification of needed further enhancement. Complete system in-flight testing is considered as the way to investigate critical areas and technology for booster stage recovery. This can be done with an experimental vehicle, i.e. a flying test-bed not fully representative of an actual vehicle, scaled down with respect to an operational booster stage to reduce the development cost. The experiences and measurement plan are an essential part of the vehicle to be defined according to the demonstration objectives. This paper presents the preliminary objectives, concepts and test plan for an in-flight system experimental vehicle of the booster stage securing the operational stage of a future semi-reusable launch system. This is discussed depending on the flight envelope and critical technical areas to be analyzed. The way to use the test beds for learning on maintenance and operational system cost objectives is considered.