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

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A COMPARATIVE ASSESSMENT OF VARIOUS METHODS FOR RECOVERING REUSABLE LOWER STAGES

Abstract

Numerous attempts to create a reusable space transportation system led to a division of this general direction into the directions of reusable spacecraft development and of reusable lower stage development. Whilst the first direction, which led to a creation of space shuttles, had not a direct regard to the realization of reusable launch vehicles, the second direction is being considered currently as one of the most promising ways to enhance the economic efficiency of launch vehicles in the nearest future. The problem of recovery of these reusable lower stages is one of most important ones that should be solved in the provision of their reusability. The methods for recovering the stages, which were either proposed, or just realized, are described in the paper. They are grouped by the characteristics of the concepts that are used. Thus, there are methods which are using 'passive' devices for an actually unguided landing onto the Earth's surface without a provision of accurate landing onto a chosen spot, the methods which are using the Earth's atmosphere as a source of aerodynamic support for the provision of the stage's return flight to a required spot, and lastly, the methods which are based on braking the stage with its own main rocket engine. The advantages and shortcomings are exposed for each of the methods in order to use them for a following comparative assessment. The listed methods are assessed and compared in the paper in order to arrive at recommendations on their using for specific applications in various types of the partially reusable launch vehicles.