Key Technology of Space Exploration (8)
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A COMPREHENSIVE STUDY OF THE DYNAMICS MOVEMENT FOR LANDING VEHICLES WITH INFLATABLE BRAKING DEVICE FOR MISSIONS LANDING IN MARS CONDITIONS

Abstract

At present, the idea has emerged to use special inflatable braking device (IBD) which permits to implement the landing vehicle (LV) "soft" landing on the planet's surface without a parachute system. Braking device (BD) unfolds still at the extra-atmospheric flight stage to provide the LV passive stabilisation, and the entire apparatus together with the braking device is twisted around its longitudinal axis. The advantage of an inflatable BD over traditional non-rigid brakes - parachutes is that it can be used at the atmospheric stage of the descent, starting from hypersonic speeds, and ending subsonic ones. These main theses are implemented in the project MetNet and its sequel project RITD, using Entry, Descent and Landing System (EDLS) system. During their movement in the planet's atmosphere, the LV with IBD are subject to high aerodynamic loads leading to a form change of a non-rigid BD shell, and to emergence of the LV with BD current asymmetries. Availability of structural asymmetries arising from the LV manufacture process leads to the appearance of various dynamical phenomena during the descent stabilized by the LV with BD rotation such as vibrational-rotational resonances and resonance autorotation changing the LV angular motion dynamics. Current asymmetries of the LV with IBD are capable of influencing the dynamic phenomena under consideration, increasing or decreasing the impact on the LV movement dynamics. The purpose of this research is to study the effect of the BD non-rigidity on the LV angular motion dynamics in the planet's atmosphere. It is necessary to take into account various disturbing factors acting on the LV at the atmospheric flight stage (e.g., mass-structural and aerodynamic asymmetries). Application of the developed method evaluating the influence of the IBD non-rigidity on the angular motion dynamics will be considered by the example of small LV destined to descend into the atmosphere. LV is an axisymmetric unit with two types of ballutes: primary inflatable braking device (PIBD) of conic type used for braking the LV after entering the atmosphere down to the altitude of a few kilometres, and additional inflatable braking device (AIBD) of conic type used in the final stage of descent.