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METHODOLOGY FOR CONDUCTING COMPLEX STUDIES OF THE DYNAMICS OF SPACECRAFT MOTION DURING DESCENT IN THE PLANET'S ATMOSPHERE

Abstract

This paper presents a methodology for a comprehensive study of the dynamics of spacecraft motion at the stage of motion in the atmosphere. As part of the ongoing comprehensive studies, the motion of the descent vehicle was considered at all stages - from entry into the atmosphere to landing, including the stage of contact with the surface and including studies of a hard landing of the descent vehicle. This approach makes it possible to verify the feasibility of the mission and to analyze the most unfavorable landing options. To reduce the speed from the values typical for the start of movement during entry into the atmosphere to acceptable values at the stage of contact with the surface, it is proposed to use inflatable braking devices that allow braking throughout the entire descent section. These inflatable braking devices have advantages in weight and design compared to traditional parachute systems. One of the significant problems of the motion dynamics of such a descent vehicle with inflatable braking devices is the occurrence of significant shape asymmetries that arise during the movement due to the non-rigidity of the inflatable braking devices. To successfully solve the problem, it is also necessary to consider the final stage of the descent - the moment of contact with the surface. The paper uses a method for calculating the interaction of the descent vehicle with the ground, which is based on the assumption that the descent vehicle continues its movement in the ground, and the trajectory of its movement is a spatial curve in the ground. For the final stage, the critical characteristic, which is the main component of the risk of landing failure, is the magnitude of the resulting overloads on the body of the descent vehicle and the container with the payload. Multilateral studies carried out in this direction show the operability of such landing devices, however, of course, each of the stages should be studied in detail. The study of various stages of motion showed the most favorable and unfavorable modes of motion in the planet's atmosphere for such a descent vehicle with the use of inflatable braking devices. The application of the presented methodology for a comprehensive study of the dynamics of the movement of a space descent vehicle helps to reduce risks and achieve the achievement of the task set for a space mission.