

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Space Structures - Dynamics and Microdynamics (3)

Author: Dr. Vsevolod Koryanov
Bauman Moscow State Technical University, Russian Federation

Dr. Victor Kazakovtsev
Bauman Moscow State Technical University, Russian Federation

ANALYSIS OF THE INFLUENCE OF SMALL ASYMMETRIES ON THE OCCURRENCE OF
PROGRESSIVE SELF-ROTATION OF A SPACE LANDING VEHICLE**Abstract**

The movement of asymmetric landing vehicles, in contrast to the movement of symmetrical (ideal variant) landing vehicles, has a several features. The main of them consist in the occurrence of such dynamic phenomena as progressive self-rotation, vibrational-rotational resonances, nutation-precession instability, auto-oscillations, and others. In this paper, the effect of small asymmetries on the conditions for the onset of a progressive self-rotation of the landing vehicle during descent in the atmosphere of the planet is considered. As small asymmetries, we consider the lateral displacement of the center of mass, the centrifugal moments of inertia, and the asymmetry of the external shape of the landing vehicle. The differential equation for the angular velocity of rotation relative to the longitudinal axis of the landing vehicle is derived and presented in this scientific paper. Clearly that the following asymmetries affect the occurrence of the progressive self-rotation of the descent vehicle: the lateral displacement of the center of mass, the centrifugal moments of inertia, and the asymmetry of the external shape of the landing vehicle relatively of the longitudinal axis. Calculations of the dynamics of the motion of the asymmetry landing vehicle have shown that the lateral displacements of the center of mass exert the greatest influence on the onset of progressive self-rotation. We note that the change in the angular velocity relative to the longitudinal axis of the descent device in the presence of a lateral displacement of the center of mass is proportional to the velocity head, the spatial angle of attack, and the lateral displacement of the center of mass. Therefore, a progressive self-rotation can occur at maximum values of the velocity head and large values of the spatial angle of attack. Similar conditions can occur if the resonance mode of the landing vehicle movement occurs at high values of the velocity head. Thus, in the work analyzes the effect of asymmetries on the occurrence of progressive self-rotation of the landing vehicle. This analysis should be carried out at the stages of designing the landing vehicles.