

PREDICTION OF DYNAMIC LOADS ON SPACECRAFT IN THE ACTIVE LIGHT OF THE LAUNCH VEHICLE USING THE RESULTS OF LIQUID-PROPELLANT ROCKET ENGINE FIRE TESTS

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In orbital injection, the launch vehicle (LV) structure and the spacecraft are subjected to extreme dynamic loads, in particular to vibroacoustic loads (from rocket engine thrust oscillations and aerodynamic loads), which may cause spacecraft instrumentation malfunction and damage spacecraft light-weight thin-walled structures. This paper is dedicated to the development of an approach to predicting dynamic loads on spacecraft in orbital injection by LVs of various layouts under propulsion system thrust oscillations in active flight.

The paper presents an approach to predicting dynamic loads on spacecraft in orbital injection by LVs of various layouts. The approach makes it possible to evaluate dynamic loads (spectral densities of vibration accelerations) on spacecraft under propulsion system thrust oscillations acting on the liquid-propellant LV structure in active flight. The approach includes a mathematical simulation of the spatial oscillations of the LV structure according to its structural layout scheme and the experimental pre-determination of the spectral density of the rocket engine power. The workability of the proposed approach in predicting the spacecraft dynamic loads is demonstrated by the example of a computational analysis of the spectral densities of spacecraft oscillations in orbital injection by LVs of various structural layouts.

It is shown that the approach allows one to predict, as early as at the initial LV design stage, the spacecraft vibratory load parameters at different times of the LV first-stage liquid-propellant rocket engine operation accounting for the rocket layout (with the spacecraft) and design features and using the vibroacoustic characteristics of the liquid-propellant rocket engine (known from the results of its fire tests).

Keywords: *spacecraft vibration acceleration, liquid-propellant rocket propulsion system, mathematical simulation, spectral density, rocket engine thrust oscillations.*

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