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Author: Mr. Shipeng KANG
Aerospace System Engineering Shanghai, China, China

Mr. Linyu SONG
China
Mr. Jie TANG
China
Mr. Zhenghui SHEN
China
Mr. Quan WANG
China

DYNAMIC ANALYSIS OF SMALL SATELLITE SEPARATION SYSTEM

Abstract

The satellite is usually separated from the launch vehicle by spring devices. The velocity and the angular velocity of the satellite at the moment of separation are key technical indexes for satellite launch mission. Especially for small satellite, it is difficult or unable to stabilize the satellite flight attitude if the velocity and angular velocity exceeds maximum permissible value.

In order to calculate the velocity and the angular velocity of the satellite at the separation moment, a dynamic equation of six-degree freedom is established in this paper. This non-linear ordinary differential equation takes into account the effects of 6 factors: the satellite mass, the centroid position of the satellite, the rotational inertia of the satellite, the deflection of the spring thrust, the thrust of the spring, and the installation position of the spring device. This equation is solved by fourth-order Runge-Kutta method. The calculation result shows that the method is feasible and accuracy, compare with the simulation results, the maximum deviation is less than 1%.

In the design of the satellite and the spring device, there is a deviation range of the above 6 factors. In this paper, the influence of the design deviation of the above 6 factors on the velocity and the angular velocity of the satellite is also studied by sensitivity analysis. The analysis results indicate the satellite mass deviation is the main factor affecting the separation velocity, while other factors have little effect on it. For separation angular velocity, the satellite centroid position deviation and the angle deviation of the spring thrust are the main factors, and then are the spring installation position deviation and spring thrust deviation, while satellite mass deviation and satellite inertia deviation have little effect on it.

Through the dynamic analysis of the small satellite separation system, it can improve the reliability of the satellite launch. The above research results can provide technical reference for the satellite design and separation mechanism design, and also provide reference for the optimization of the separation velocity and the angular velocity.