SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations (IP)

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THE KINEMATICS ANALYSIS ON SWAY UNIT OF LOX/KEROSENE ROCKET ENGINE

Abstract

The large-thrust LOX/Kerosene rocket engine which is capable of swaying is the main power of China's new generation Long March series of launch vehicles. With the help of the swinging engine, it is more simply and efficient for the rocket to control the flight directory by swinging the engine directly. The sway unit used as a flexible joint is the key assembly to achieve the swinging movement of engine.

The core component of sway unit is a tubular channel, which is referred as swinging hose. As the swinging hose is fitted in gimbal apparatus, the engine sways around the axis of gimble apparatus. For keeping uniform deformations and avoiding structural instability or failure caused by excessive local deformations of sway hose, it is necessary to coincide the symmetry axis of sway hose and gimbal apparatus, which is called 'Best Assembly Relationships'. However, for achieving the demands of reasonable layout and compact structure, the swinging hose is not actually in 'Best Assembly Relationships'. Consequently, it induces uneven deformations in swinging hose, which may weaken the strength, stiffness, and stability. So, it is a prerequisite job to obtain the motion features of swinging hose accurately for designing the overall layout of engine.

In order to acquire the deformations of swinging hose, a method to analyze different kinds of swaying movements is developed. Firstly, the movements of single swing DOF is analyzed, which shows that the swinging hose bends purely. When the angle between sway axis and installation axis is 45º, the swinging hose deforms uniformly and gets the minimum distortion angle which is about 70