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# DYNAMICS ANALYSIS FOR THE GIMBALLING INSTALLATION OF THE LOX/KEROSENE ROCKET ENGINE

**Abstract**

The Lox/kerosene staged combustion cycle engines which will be used in the new generation launch vehicles have been successfully developed by China. Nevertheless, owing to the present tendencies of improving vehicle launching capability, reliability and further cost reduction, it is especially important to upgrade the new rocket engines continually. In order to improve the rocket engines, the new configuration of Lox/kerosene staged engine is investigated. The gimballing installation is one of the key components of the new configuration, and operates in the harsh conditions, such as high temperature, high pressure, and hot oxidizer-rich gas. What's more, it is essential to study the dynamics characteristic of the gimballing installation due to the significant effects on the structural reliability and thrust-vector control of rocket engine. Consequently, the dynamics analysis of the gimballing installation is presented in this paper. The gimballing installation consists chiefly of structural supports and flexible bellows. Dynamics analysis is a great challenge due to the complexities in geometry of the gimballing installation, and the industrial problem leads to a large finite element model which is time-consuming in calculating or optimizing processes. An effective technique to reduce calculation time is the component mode synthesis (CMS). CMS is a modeling technique that involves dividing the full dynamics system into smaller components. The dynamic behavior of each of the components is estimated, and the equilibrium and compatibility along component interfaces must be satisfied. CMS is suitable for predicting the dynamic behavior of large structure. Accordingly, the dynamics model of the gimballing installation is established, which is based on CMS method, and the natural frequencies are given in this paper. In order to validate the accuracy and reliability of dynamics analysis, the modal test of the gimballing installation is carried out. The predictions of dynamics characteristic are in accord with experimental results very well. It is proved that the numerical method is feasible, and an effective technique to solve the components of complexity shape is achieved. Furthermore, the research works are helpful on fulfilling the reliability design of the gimballing installation and establishing the dynamics model of the whole engine.