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INVESTIGATION OF DYNAMICS CHARACTERISTICS OF THE HOT GAS BELLOWS OF THE LOX/KEROSENE ROCKET ENGINE

Abstract

The hot gas bellows is one of the key components in the LOX/kerosene high pressure staged combustion cycle engines, which can be used to transport hot oxidizer-rich gas and realize the thrust vector control(TVC) method of swing thrust chamber. The hot gas bellows operates in the harsh conditions, such as high temperature, high pressure, and hot oxidizer-rich gas, and consists chiefly of strengthened ring, multilayer flexible bellows and flange. The dynamics analysis is a great challenge due to the complexities in geometry and nonlinear features of large deformation and contact. Owing to the significant effects on the structural reliability and TVC of rocket engine, the dynamics characteristics of the hot gas bellows has been researched.Firstly, the nonlinear dynamics model of the hot gas bellows is established ,and the contact effect between each layer, the geometry and material nonlinearity are all considered in the model. In the second place, prestressed nonlinear modal analysis is conducted. In order to validate the accuracy and reliability of dynamics analysis, the simulation results are compared with the modal test of the hot gas bellows. Further, the structure parameter sensitivity on the first order frequency of the component, such as pitch, wave height and layer numbers etc. is analyzed. Finally, According to the parametric sensitivity analysis results, the improvement approach of the frequency characteristics is given. It is proved that the numerical method is feasible, and an effective technique of nonlinear modal analysis is achieved. Furthermore, the research works are helpful on fulfilling the reliability design of the hot gas bellows and establishing the dynamics model of the whole engine.