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EFFECT OF BEARING SUPPORTING STIFFNESS ON CRITICAL SPEED AND DYNAMIC STABILITY OF TURBO-PUMP ROTOR SYSTEM IN LOX/KEROSENE ROCKET ENGINE

Abstract

The critical speed is one of the major dynamic characteristics parameters of rotor system for liquid rocket engine. With the rotating speed increase, the critical speed is very important to ensure the safe and reliable operation of the engine. The influence of the beating supporting stiffness on critical speed and dynamic stability of turbo-pump nonlinear rotor system of LOX/Kerosene rocket engine (YF-100) is researched in this paper. The nonlinear rotor system dynamic model is established considering nonlinear factors of the bearing, the inertia distribution, shear, transverse torsion, structural geometric parameters of the rotor system. The effect of supporting stiffness change of the beating near the pump and the bearing near the turbine on the critical speed and stability of the rotor system is respectively researched under the condition of installation decentration. A continuation algorithm combined with shooting method is presented to evaluate and track the periodic response bifurcated from the Hopf bifurcation of a balanced rotor system. The stability of periodic solutions induced by the Hopf bifurcation is analyzed. The bifurcation plot, phase plane plot, frequency spectrum and Poincaré map are used to carry out the analysis of bifurcation and chaos motion. This study provides a theory for optimum design, fault diagnosis and safe operation of the turbo-pump rotor in the liquid rocket engine.