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TURBOPUMP ROTORDYNAMIC ANALYSIS FOR A 75TON CLASS LIQUID ROCKET ENGINE

Abstract

A rotordynamic analysis is performed for a high thrust class liquid rocket engine turbopump considering the dynamic characteristics of ball bearings and pump noncontact seals. Complex eigenvalue problems are solved to predict the rotating natural frequencies and damping ratios as a function of rotating speeds. Synchronous rotor mass unbalance response and time transient response analyses are also performed to figure out the rotor critical speed and the onset speed of instability. The effects of various bearing stiffness and pump seal functioning on the rotordynamic behavior are investigated. From the numerical analysis, it is found that the rear bearing stiffness is most important parameter for the critical speed and instability because the 1st mode is turbine side shaft bending mode. The pump seal effect on the critical speed is enlarged as the rear bearing stiffness decreases and the front bearing stiffness increases. The ratio of the instability speed to the critical speed come out to be increased as the rear bearing stiffness become smaller. An experimental evaluation of the rotordynamic characteristics is to be performed through the turbopump high speed test in the near future.