UNBALANCE RESPONSE CONTROL IN HIGH-SPEED GAS TURBINE SYSTEM USING MAGNETO-RHEOLOGICAL FLUID BASED SEMI-ACTIVE SQUEEZE FILM DAMPER

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ABSTRACT

The high-speed gas turbine used for aircraft propulsion system consists of dual (high- and low-pressure spools) rotors, supporting ball bearings, and an oil-lubricated squeeze film damper (SFD). In this work, a magneto-rheological fluid based SFD (MR-SFD) is introduced, as an attempt to replace the conventional SFD, in order to investigate its capability of attenuating the unbalance response as the rotor system passes through the critical speeds. The finite element model of the dual rotor equipped with the MR-SFD is established, and then, an input-scheduling algorithm based on the singular value analysis is utilized to determine the optimal input current level so that the maximum relative stability of the rotor system is attained. It is found that the MR-SFD is very effective in attenuating the unbalance response over the critical speeds associated with the low-pressure spool rotor, not with the high-pressure spool rotor, because the MR-SFD directly supports the low-pressure spool rotor only.

Keywords: Magneto-rheological Fluid, Squeeze Film Damper, Unbalance Response Control, Dual Rotor, Singular Value Analysis