INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

Gas foil bearings (GFBs) has been considered as an alternative to traditional bearings in recent turbomachinery industries. However, the applications of Gas Foil Bearings have been narrowed due to low damping and nonlinear characteristics. Moreover, the presence of sub-synchronous and super synchronous frequencies introduces undesirable nonlinear effects to the system. This necessitates a non-conventional bearing system, which can overcome all these shortcomings. The current trend is to develop hybrid bearings which combines conventional bearing (GFB) along with active magnetic bearing as an electromagnetic actuator (EMA). In the present study, a coupled dynamic model combining the dynamics of GFB and EMA has been developed. The fluid film forces from the GFBs and the electromagnetic forces from the EMAs are integrated into the equations of motion of the rotor. The developed model has been used to investigate the stability and unbalance response of the rotor supported on GFB. It has also been observed that the sub synchronous vibration which is dominating in conventional GFB, is eliminated using the hybrid GFB. Moreover, the hybrid GFB is capable of adapting to the sudden unbalance. It has also been observed that a high magnetic force is required to control the rotor for a set reference value other than the natural steady-state value of the response of the rotor supported by GFB without the effect of EMA. Further, the cost of the combined bearing system will be much higher compared to its individual bearing. Therefore, in this work, a new electrical winding scheme for the electromagnetic actuators of the hybrid Gas Foil Bearing has been proposed. The new arrangement requires only two drives per bearing and the bias current has been provided (in the same set of windings) through a simple rectifier with small series choke and shunt capacitor. As the number of drives required is less, the proposed bearing will have low cost. Implementing the new approach, the force vectors are achieved using only two current source drives whereas the usual conventional arrangement requires four such drives. The new control approach removes the usual constraint of bias current. With the knowledge of the state of the currents in the bearing and the bearing rotor position, the forces present in the bearing are calculated at any one instant, and the controller is updated at high rates.