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OPTIMUM DESIGN OF SHIMMED FOIL BEARING CONSIDERING ROTORDYNAMIC STABILITY

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Abstract

Air foil bearing technology has made substantial development in the past years and has found its applications in high speed turbomachinery. Yet the rotordynamic instability has still been a persisting issue in the single pad air foil bearings. The single pad bearing can resolve this issue by using large clearance with the shaft but the large clearance requires large impeller tip clearance which is not ideal. Multi pad air foil bearings with non-uniform clearance distribution can be used to improve the rotodynamic stability, but the three pad bearings have inferior load capacities due to the less angular length of each pad. To obtain the superior load capacity of the single pad bearing and the rotordynamic stability of three pad bearings, shimmed bearings are introduced. All the previous papers on the shimmed air foil bearings have considered various parameters of the shims to optimize the design but have not performed the analysis by considering the rotordynamic stability. This paper investigates the effect of design parameters of the shim, such as angular span and angular position, on the stiffness and damping characteristics of the bearing. The obtained stiffness and damping characteristics of the single pad shimmed air foil bearing are compared with those of three-pad bearing and the advantages of using a shimmed bearing are discussed. A methodology to optimize the design parameters of the shim to improve the rotordynamic stability of the bearing is shown. Optimized shim parameters are found for a 70mm bearing which is used in 150kW turbo blowers.