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Dynamics of a turbocharger rotor supported on floating ring journal bearings with shallow axial grooves of uncertain dimensions

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Abstract: Rotors of turbochargers are supported in floating ring journal bearings (FRJB) in most applications because these bearings are cheap and are not prone to the fatigue damage unlike rolling element bearings. However, due to their design with two oil films, FRJBs cause non-linear vibrations and instability of the turbocharger rotors, and also high power losses. Both dynamic and tribological properties of the bearing can be improved if several shallow axial grooves are machined in the inner surface of the floating ring. The grooves are usually not manufactured precisely in order to keep the cost of production as low as possible. Engineering tolerances may even be of the same order as the bearing clearance. This work deals with an analysis of dynamics of the turbocharger rotor supported on FRJBs with shallow axial grooves of uncertain dimensions. More specifically, the effects of the precise grooves on dynamics of the system are explained and then the influence of the uncertainties on both vibrations and hydrodynamic power losses in the bearings is investigated. In order to do so, a robust numerical approach is used: motions of rotating bodies are described employing a multi-body system formalism and forces acting in the bearings are calculated with a finite-element model which considers some thermal effects.

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