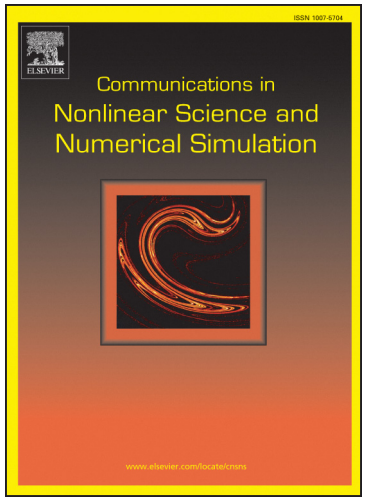

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A new nonlinear dynamic model of the rotor-bearing system considering preload and varying contact angle of the bearing

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Abstract

A great deal of research work has been done on the dynamic behaviors of the rotor-bearing system. However, the important effects of load and variation of contact angle on the bearing performance have not been focused on sufficiently. In this paper, a five-degree-of-freedom load distribution model is set up considering the bearing preload and the loads due to the rotor imbalance. Utilizing this model, the variation of the bearing contact angle is investigated thoroughly. The comparisons of the obtained contact angle against the results from literature validate that the proposed load distribution model is effective. With this model, the static ball deformations are obtained considering variation of the contact angle. Through resolving the dynamic displacements of the rotor, the dynamic ball deformations could also be obtained. Then the total restoring forces and moments of the bearings could be formulated. By introducing these nonlinear forces and moments into the rotating system, a new dynamic model considering the preload and the variation of contact angle is set up. The present analyses indicate that the bearing contact angle will be changed remarkably with the effect of bearing load. The deflection vibration of the rotor-bearing system will be underestimated without considering the varying contact angle. With the effect of varying contact angle, the ball passage frequency and its combinations with the shaft rotating frequency become more noticeable. The main resonance regions for the rotor-bearing system shift to the lower speed ranges when the variation of contact angle is taken into account.

Keywords: Rolling element bearings; Rotor-bearing system; Nonlinear responses; Contact

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