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Effect of the rotor support elements lubricated by magnetic fluids on chaotic and regular vibration of rotors during rubbing

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Abstract: To achieve a compromise between the vibration attenuation and minimization of the forces transmitted to the stationary part a new rotor support element has been designed. It consists of a squeeze film bearing lubricated by magnetically sensitive oil and of a hydrodynamic bearing inserted in it. The damping is controlled by changing the magnetic field passing through the layer of magnetic fluid. This paper deals with influence of the proposed support element on character of the rotor vibration during the rotor rubbing. The rotor consists of a flexible shaft and of one rigid disc placed in a hole in the stationary part. The pressure distribution in the oil films is governed by the Reynolds equations, classical and the one adapted to magnetic fluids. The dry friction is considered during the collisions. The rotor vibration is described by a set of nonlinear differential equations of the first and second order. The goal of the study was to investigate effect of the magnetic field on regularity of the rotor vibration. The results of the computational simulations show that in cases when the collisions occurred (i) character of the induced vibration depends on speed of the rotor rotation (the chaotic, quasiperiodic and periodic vibration was observed) and (ii) application of the magnetic field can change irregular oscillation into regular one. The performed study contributed to learning more on the effect of magnetically controlable fluids lubricating the rotor bearings on the rotor vibration character in dependence on speed of the rotor rotation.

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