Investigations of rotors supported by passive magnetic bearings with radial magnetization

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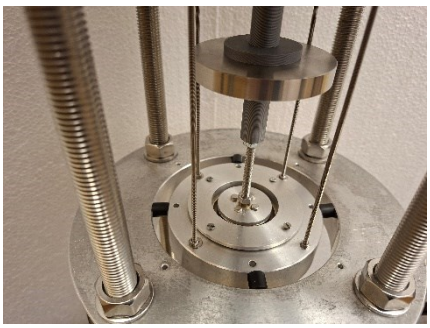
A common requirement on design and operation of rotating machines is minimizing energy losses and wear of the support elements. This is offered by application of contactless passive magnetic bearings [1, 2]. The goal of the research performed was investigation of effect of adding damping elements on the rotor vibration.

The investigated system is a vertical rotor supported by a passive magnetic bearing at its lower end and by a rolling element bearing at its upper end. The magnetic bearing is composed of two permanent magnetic rings with radial magnetization. The outer magnet is connected to a ring coupled with the stationary part by a cage spring and rubber damping elements. When the rotor rotates, it is loaded by unbalance.

In the computational model the shaft was represented by a beam-like body that was discretized into finite elements, the disc and the magnetic rings were regarded as absolute rigid. The rubber elements were represented by beam bodies. The nonlinear magnetic forces acting between the rings of permanet magnets were determined by means of the dipol-dipol method. The laboratory experimental system consists of a stationary part formed by a stiff supporting structure and of a vertical rotor. The magnetic bearing with the rubber elements and the rotor disc can be seen in Fig. 1.

Both computational simulations and experimental research show that presence of the rubber elements suppresses some resonance frequencies and free oscillations induced during passage of the rotor through the resonance areas, which makes the rotor vibration much smoother.



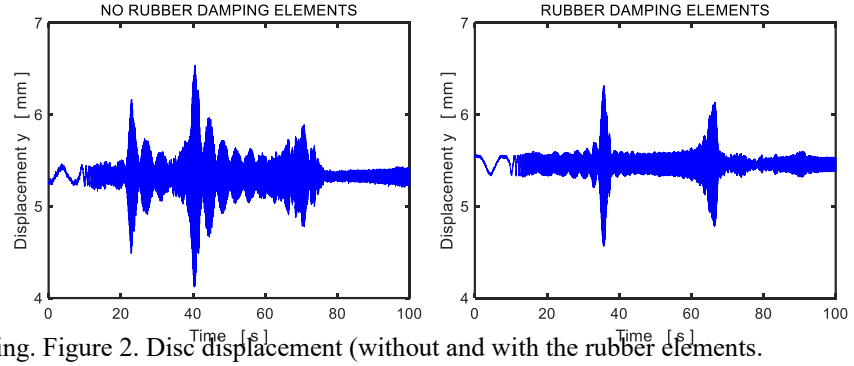


Figure 1. Passive magnetic bearing. Figure 2. Disc displacement (without and with the rubber elements.

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