Chaos caused by hysteresis in 2-dof vibrations of the rotor suspended in a magneto-hydrodynamic field

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2-dof nonlinear dynamics of the rotor supported by the magneto-hydrodynamic bearing is studied. In the case of soft magnetic materials the analytical solutions are obtained by means of the method of multiple scales. The non-resonant case and cases of primary resonances with and without an internal resonance are investigated. The frequency-response curves are obtained. The saturation phenomenon is demonstrated. When the amplitude of the external excitation increases, after some critical value the energy pumping between various submotions of the rotor occurs. A comparison of the analytical and numerical solutions based on the approximate harmonic analysis is made. Hysteresis in this system is considered using the Bouc-Wen hysteretic model. It was shown that hysteresis generates chaotic vibrations of the rotor under certain conditions. Influence of hysteretic dissipation on chaos occurring is investigated using an approach based on the analysis of wandering trajectories. The chaotic behavior regions of the rotor are obtained in various control parameter planes: amplitude of external harmonic excitation versus dynamic oil film action characteristics as well as versus magnetic control parameters, hysteretic dissipation and frequency of external excitation. Amplitude level contours of horizontal and vertical vibrations of the rotor are obtained.