Recent progress in electrodynamic magnetic bearing.

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Magnetic bearings provide guidance for rotor through the action of electromagnetic forces, avoiding contact between the parts in relative movement. This contactless characteristic results in an absence of wear and of mechanical friction and makes this type of bearings very attractive, and even impossible to circumvent when operating at very high speed or in vacuum, compared to more conventional solutions such as ball bearings. Magnetic bearings are usually classified into two categories: active magnetic bearings (AMB) and passive magnetic bearings (PMB).

AMB are made of several electromagnets on the stator attracting a ferromagnetic rotor. This attraction force, intrinsically unstable, is controlled according to the rotor position by adjusting the electromagnets currents. To operate, AMB therefore require a power supply, a control electronic and sensors.

Compared to AMB, PMB use neither electronics nor sensors. They are therefore more compact, cheaper, and consume less energy. They are also intrinsically more reliable. Among these latter, permanent magnet bearings have very interesting performance in terms of stiffness and load capacity [1]. However, they cannot ensure a stable behavior along all the degrees of freedom of the rotor [2], and must be combined with other types of bearings able to counteract this instability. Electrodynamic bearings (EDB), whose operating principle is based on forces generated by the appearance of induced currents within conductors in relative movement with respect to permanent magnets, constitute a prime candidate to play this role. This has been confirmed by several research programs on the development of completely passive magnetic suspensions combining permanent magnet bearings and electrodynamic bearings [3-5].

In this context, the objective of this paper is to give an overview of the main topologies of EDB, the various modelling approaches and models developed for predicting their static and dynamic behavior, and the design methodologies implemented for comparing and optimizing these kinds of bearings. This paper also discusses the possibility of developing EDB-based bearingless machine as recently unveiled [6].

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