Design and Experimental Testing of a Heteropolar Electrodynamic Bearing

Corentin Dumont[1], Virginie Kluyskens[1] and Bruno Dehez[1]

[1] Center for Research in Mechatronics (CEREM), Institute of Mechanics, Materials and Civil Engineering (IMMC), Universite catholique de Louvain (UCL), Louvain-la-Neuve 1348, Belgium

Magnetic bearings allow to support a rotating object without contact. Nowadays, the majority of the magnetic bearings used in the industry are controlled actively. However, the complexity, cost and overall dimensions associated with this control system can be prohibitive, e.g. for small rated power applications.

A way to overcome these disadvantages could be the use of magnetic bearings without external control means, i.e., passive bearings. Passive magnetic bearings can be obtained through permanent magnet bearings, but those latter do not allow to guide a system along all their axis in a stable manner. Other passive magnetic bearings include electrodynamic bearings. Electrodynamic bearings generate guiding forces by the interaction of a permanent magnetic field and currents induced by the motion of this magnetic field. Usually electrodynamic bearings are designed to be null-flux bearings, which means that there are no currents induced when the moving part is at its equilibrium position.

Radial homopolar electrodynamic bearings have focused much interest in recent years, resulting in dynamical models , protoypes and a sucessfull levitation test . Heteropolar electrodynamic bearing present a structure closer to permanent magnet motors and allows to build a device using existing components developed for electrical motors, thereby reducing production costs. Recently a new dynamical model removing quasi-static assumptions or other limitations present in previous models was proposed, allowing to study a wider variety of centering heteroplar bearings. Consecutive to this model, a prototype of a centering electrodynamic bearing with a radial magnetic field has been constructed (Fig. 1). This paper presents quasi-static experimental results on this bearing, and their comparison with the predictions of recent dynamical model, in terms of electromotive force and in terms of radial forces. It shows the good agreement between the model predictions and the experimental results, but also the difficulty of obtaining a true null flux heteropolar bearing.

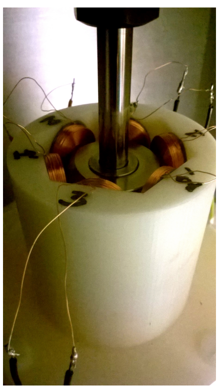

Figure 1: Prototype of centering heteropolar electrodynamic bearing

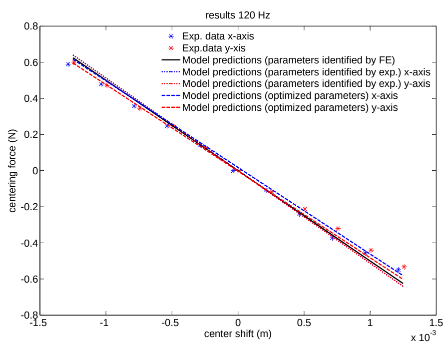

Figure 2: Centering force when the rotor spins at 120Hz