730. The rings with molecular current as the model of the passive magnetic bearing

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Abstract. There will be presented a model of a passive magnetic bearing. The model uses the ring with molecular current as a source of external magnetic field (the unmovable magnet mounts in a case of machine). The next ring with molecular current moves in external field generated by unmovable ring (the magnet connects with the shaft of machine). The density of magnetic field is obtained from the Biota-Savart law and the force is estimated from the Lorentz law. Moreover, there will be estimated the damping factor proportional to the speed of the movable magnet. The model can be used to design the radial passive magnetic bearings.

Keywords: passive magnetic bearing, molecular current, magnetic force.

Introduction

The passive magnetic bearings have got a lot of advantages. They eliminate friction between rotate elements of machine and remove cooling and lubrication system. The passive bearings don’t power during a work and they are cheaper than active magnetic bearing. These bearings have got disadvantage. They don’t assure coaxial position a rotor in an air gap and those are unable to design isolated system of magnetic suspension. The full system of magnetic levitation must one degree of freedom controlled by active magnetic suspension or other system of position stabilization.

The active magnetic bearing has got feedback loop between the position of rotor in the air gap and the magnetic force. The passive magnetic bearing hasn’t got feedback loop. The repulsive or attractive magnetic forces in the passive magnetic bearing are resulted from magnetism phenomena [1].

The estimation of the property of the passive magnetic suspension as damping coefficient, natural frequency and stiffness coefficient is very difficult. The magnets generate the non-uniform magnetic field and the value and direction of magnetic field depend from point around the magnet. The classical approach doesn’t give a good result. Only the finite element method makes possible evaluation of the passive magnetic bearing. Available different models are describing the passive magnet bearing [2] and [3].

The ring with the surface molecular current was presented by author as a mathematical model of the passive magnet bearing. There is derived damping and stiffness coefficient of the passive magnetic bearing. The resultant magnetic forces depend from molecular surface current and inductive surface current. The first part of paper is presented experimental result and the second part is mathematical model damping and stiffness forces. The experimental result formulates problem, which is solve in the second part.

The experimental result

The step response of the passive magnetic bearing was used to estimate the damping coefficient. The passive bearing was excited by the active magnetic bearing. There was changed a current in the winding of the active magnetic bearing. The step of current was generated a step of magnetic force which snatch away the rotor from nominal position [4]. The move of rotor was transform to the passive magnetic surface by the rigid shaft (Fig. 1).