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ANGULAR SELF-SENSING ALGORITHM OF LORENTZ FORCE TYPE INTEGRATED MOTOR-BEARING SYSTEM

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ABSTRACT

Recently, a disk type integrated motor-bearing system using Lorentz force design principle has been developed in the laboratory. It is composed mainly of a stator with six windings and two rotor disks of eight-pole permanent magnets. One of the disadvantages of the Lorentz force type integrated motor-bearing system is that it requires an angular position sensor to perform commutation between the torque control current and the angular position of rotor.

In this paper, an angular self-sensing algorithm is proposed and implemented to a Lorentz force type integrated motor-bearing system, so that the system can be made compact in size, light, and reliable. It is based on the principle that the flux linkages of stator windings, calculated from the voltage and torque control current, are the functions of the rotor angle. The tracking angular position error is proven to converge toward zero using the Lyapunov stability method, and the experimental results show that the initial error decays within about 4 seconds. It is found that the angle resolution of the algorithm remains about 1º over the speed range of 100 to 1000 rpm. The error sources are analyzed and experimentally identified.

Keywords: Integrated motor-bearing system, self-sensing, Lorentz force