Abstract of Main Thesis

mo. 6 da. 30 yr.2010

Title of Thesis

A Study on High Performance Axial-Gap Self-Bearing Motor for Practical Applications

Phonetically in Japanese Hiragana

Name of Applicant Applying for the Degree:

ぬえん くあん でぃっち
NGUYEN QUANG DICH

Abstract on the Content of the Applicant's Thesis

Axial-Gap Self-Bearing Motor (AGBM) is an electrical combination of an axial flux motor and a thrust magnetic bearing. Hence, it can simultaneously provide rotation and axial levitation. In this study, modern control structure is proposed and implemented for the salient and non-salient AGBM drives with and without speed sensor.

Firstly, the modern vector control is developed for the 2-DOF salient and non-salient AGBMs using encoder. Control method design bases on their intrinsic characteristics to give the highest quality of axial displacement and speed. With this success, the AGBM drive is closer to the state-of-the-art AC motor drives. To understand the difference between two kinds of the AGBM, performance comparison is also given.

The use of the encoder causes several disadvantages such as increasing cost and size and reducing reliability in harsh environment. Therefore, in the second step, sensorless control strategies are proposed to solve these problems. The sensorless approach is based on the estimation of the back-EMF through Luenberger observer (LO) and sliding mode observer (SMO). The utilization of the LO has some advantages such as simplicity and less generated noise, however it has limitation in high dynamic response; while the use of the SMO can support high dynamic response but generates more noise.

Thirdly, a 6-DOF AGBM is constructed using a hybrid magnetic bearing system to confirm that the complete non-contact levitation can be realized by a simple construction and control system. The experimental results reveal that the performance of the AGBM drive is significantly improved. The AGBM can reach maximum speed of nearly 11000rpm.

Finally, a study of the maglev vacuum pump using the AGBM is presented. The pump is developed to work at extremely low temperature for years without any interruption on a maintaining process of the bearing system thanks to the non-contact capability of the AGBM.