Experimental Setup for Predicting Remaining Useful Life of Permanent Magnet Synchronous Motor

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1. Introduction

Recently, permanent magnet synchronous motors (PMSM) are widely used in electric vehicles and other industrial applications due to their high efficiency and high ratio of torque to weight. In some applications that require continuous operation, breakdown of PMSM causes catastrophic safety issues as well as economic loss [1], [2]. Therefore, there has been much research focusing on improving the reliability and safety issues in PMSM.

Condition-based maintenance (CBM), which continuously monitors the state of the system, and predicts failures in advance is an effective strategy for efficiently operating the system including the motor in various applications. Contrary to traditional maintenance method, which is performed after failure, or maintains the system periodically to prevent a failure, the health state of system is monitored based on its operating conditions to determine appropriate maintenance schedule in CBM. The prognosis of the failure in advance is the first step in CBM and the prediction of the remaining useful life (RUL) to the point where maintenance is required after failure prediction is the second step. RUL can be determined based on analyzing the data pattern, which is used to detect faults, and its change. [3].

This study focused on the detection of representative types of failures of PMSM such as static and dynamic eccentricity and demagnetization fault. It also includes research on predicting RUL from the time of signs of such failure are detected to the time of catastrophic failures.

2. Experimental setup

The experimental setup was designed as shown in Fig. 1 to induce eccentricity faults caused by bearing failure of motor. Weights that adjusts the load level in the radial direction of the shaft is installed in order to induce effective failure of the bearings in PMSM. Sensors for measuring current, vibration, acoustic, temperature, shaft deflection were installed and these monitor the state of the PMSM in the real time.

The data measured by this experimental device can be used to predict RUL from the time when detectable degradation occurs to the time when a breakdown occurs. The remaining life is predicted through analyzing the degradation pattern of the PMSM by applying various load levels. Detailed experimental results will be presented at the conference.

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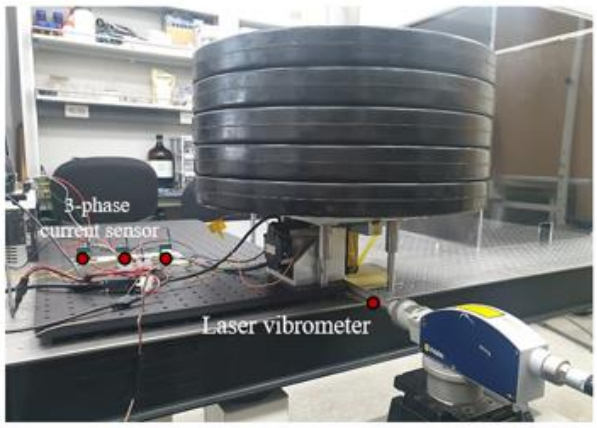

Fig. 1 Overview of testbed

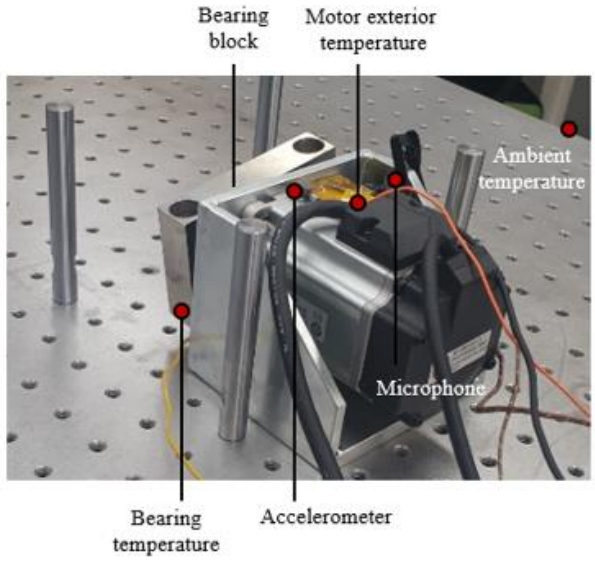

Fig. 2 PMSM used in this study (400W) and

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