Model Based Monitoring

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Abstract

Woodward manufactures, distributes, and designs motors for various industries and applications. This project focused on actuators primarily used in aircraft control surfaces. The set-up created for testing is a closed loop system which uses a coupled dummy load motor and resistor bank.

A MATLAB Simulink model will compare ideal and faulted conditions to establish a baseline with data collected from the physical motor testing. This data can then be used to establish the expected performance of the motors for the development of an algorithm which can be used to detect wear patterns.

Introduction

One focal point of the Model Based Monitoring system is Woodward’s research on motor control and solutions to motor failures. This model focuses on faulty stator windings of brushless DC (BLDC) motor. These faults commonly occur as the insulation becomes worn or cracked during operation.

Creating a model that compares the patterns of operation of a motor with stator winding wear to a new motor will help in the development of a tool that can predict faults.

Methods and Materials

The Three Phase BLDC Motor Kit from Texas Instruments (TI) was the base of the project. The team physically manipulated the BLDC motor with an external circuit and an additional BLDC motor serving as a load to simulate stator winding faults. MATLAB Simulink performed data analysis of the faulted motor.

Results

The motor testing set up has been wired and soldered to a point that the project can be easily continued in later phases. Motor mounts were also designed for use in the completed board. The model has been created to simulate the behavior of a brushless motor in ideal conditions along with modifications to show the behavior during a stator winding fault which is represented by a current leak.

Conclusions

Model-based monitoring for 3-phase motors will create a simulation tool to assist in motor failure predictions. Through testing and data acquisition, a MATLAB Simulink program has been created to simulate stator winding faults in BLDC motors.

Further work on the system will be able to find trends and operational baselines for the test motors which will help with the identification of impending failures or faults. Being able to identify these faults early would allow for the development of maintenance plans which are more accurate and customizable to the environment that the motors will be serviced in.

With this project, Woodward also seeks to improve the accuracies of lifespan calculations for in-service motors across a variety of actuators that they design and manufacture.

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