Modeling Bearing Temperature of DC Machine in No-Load Condition Using Transfer Function

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Abstract Bearing is a critical component in an electrical machine which get continuous monitoring and included in scheduled predictive maintenance. The temperature of the bearing is a valuable information that may allow early fault detection, lubrication assessment, and overloading indication of the system driven. Using the temperature measurement of the bearing and comparing it to a baseline temperature in real time will allow early warning of any eventual fault. This paper proposes a thermal model for the bearing in a brushed DC machine, developed using transfer function that will predict the temperature increase contributed specifically by speed variation. The transfer function was found by identification using experimental temperature of the bearing at a speed ranging from 20 to 100% of its rated speed while being at no load. The result shows that the first-order transfer function was found to be the best with a model identification MSE of less than 0.23. The slight variation on the poles of the system indicates that the thermal system of the bearing inside an electrical machine does not obey exactly the LTI hypothesis.

Keywords Bearing · Thermal analysis · Transfer function · Condition monitoring · Brushed DC machine

1 Introduction

Bearings are critical components that support rotating shafts and are subject to various stresses, including friction, load, and vibration. They are also expected to perform efficiently and safely while being one of the most stressed components and thus need regular monitoring. Elevated temperatures can indicate potential problems or failures within the bearing system. Across different area of applications, the problems related to bearing temperature has been the topic of much research. This is especially amplified by the ever-growing motor or generator-driven application in this electrification era. For example, in renewable energy, the problem of bearing temperature

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