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Condition Monitoring of Fault Diagnosis under Lubrication Condition in Ball Bearing using Infrared Thermography

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Abstract

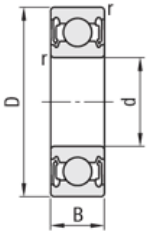
In this paper, the novel approach for the rotating machine as diagnosis method in detecting the faults during its operation was proposed based upon the infrared thermograph technique. As experimental works, by performing the test of operation at several lubrication conditions for the ball bearing applied in the rotating machine which there has been used broadly, diagnosis evaluation and fault analysis for temperature distributions provided from infrared thermogrphy were carried out. As results, the local region defect of the bearing to use the infrared thermal image technique was analyzed. Also, it was concluded that the location of the exact crack and size and lubrication condition could be confirmed.

1. Introduction

Through past decades, non-destructive inspection technology has been widely used and its leveraging range is continuously growing trend. Recently, conditions monitoring for equipments and facilities with shock or vibrations like rotating devices in machinery have been required and the application of infrared thermograph technology as a monitoring tool for targets with own heat dissipations was useful, in which a non-destructive testing (NDT) as a passive infrared thermography was applied.[1,2] Since infrared thermography method with high performances in sensitivity and resolution could scan a large area at the same time as one of non-destructive tastings, this infrared technology extended its applications including to detect cracks, delamination of defects.[3] On the other hand, as a methodology of condition monitoring with several advantages such as real-time detection and remote detection, it could be applied into the area of automotive, aerospace industry and nuclear plants. Currently, the applications of infrared applications were quickly expanded to the field of fault detection techniques and its utilizations of condition monitoring for the diagnosis were widely increased [4,5]. In this study, using the infrared thermography method for the diagnosis of ball during operation, evaluation of fault detection was carried out by experiments

2. Experimental work

Fig. 1 (a) shows the photography of fault simulator in the experimental apparatus and Fig. 1 (b) shows the schematic diagram of a ball bearing experimented in this work. For experiments, the type of ball bearing are kinds of B60XX



(a) Fault simulator set-up for experiment (b) Schematic of ball bearing

Fig. 1 Experimental arrangement of ball bearing fault diagnosis

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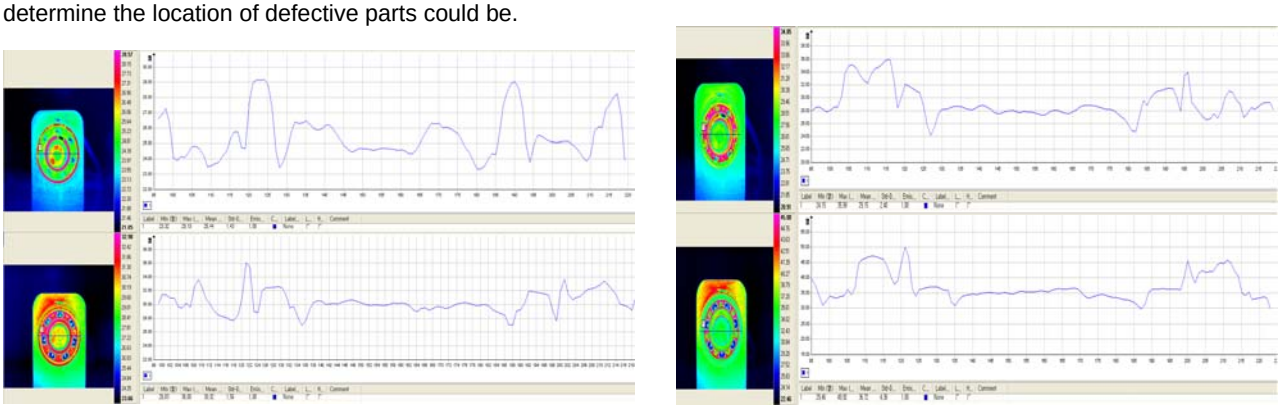
Table 1 Specifications of ball bearing of B6304

Outer diameter, D (mm)	Inner diameter, d (mm)	Width, B (mm)	Allowable revolution (rpm)	Mass (kg)
52	20	15	10,000	145

as standard bearing, which is B6004, B6204 and B6304 of the single-row deep groove ball bearings, respectively. Table 1 shows the specifications of a typical ball bearing applied in the axis, and where ball bearing was hot by heating during operation, and the servo motor for the operation was APM-SC08ADK. And, by controlling the velocity with a power of 1HP of 800W, experiments was conducted. During the experiment, the intrados, extrados and ball of bearings were applied as artificial cracks to detect the fault as condition monitoring. As experimental works, fault analysis during operation was performed by comparing the temperature distributions between normal and cracked bearings. [6] From discussions it was analyzed the temperature evolutions of bearing following lubrication condition.

3. Results

Fig. 2 shows the case of The results of measuring is In this experiment, we can measured the bearing fault to determine the location of defective parts could be.



(a) Temperature evolutions at 1,000 rpm (b) Temperature evolutions at 3,000 rpm

Fig. 2 Using the infrared thermography system images of ball bearing fault diagnosis

4. Conclusions

From the study, the novel approach for the damage detection of the rotating machine was conducted based on the passive infrared thermography. As results, by using the ball bearing used in the rotating machine applied extensively, thermal imaging by experiment was evaluated. Also, from analysing the temperature characteristics using the infrared thermography for in-situ rotating ball bearing under the lubrication condition, it was concluded that infrared thermography by condition monitoring for the rotating machine at real time could be utilized in many industrial fields.

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