An Optoelectronic Method of Machine Diagnostics

Assoc. Prof. Totyo Iliev, Ph.D

INTRODUCTION

Correct assessment of current and prospective operating order of technical objects involves the use of technical diagnostics.Using systems and equipment for technical diagnostics which employ objective quantitative criteria will have, on the one hand, a positive impact on decision making related to the correct selection of the right operation mode of a particular electric machine and , on the other hand ,will determine its performance capacity.. Various well known methods of technical diagnostics of electric machines include parameter-based diagnostics ,simulation diagnostics, high frequncy test diagnostics , impact-pulse diagnostics, flaw detection, etc.

Two major aspects of application are derived from these methods: manufacturing and performance.

This paper presents an option which employs optoelectronic method of diagnostics that eliminates direct contact with the object. Further advantage of this method is the possibility to ensure motor control as well.

EXPOSITION

In electric machines there are parameters which do not lend themselves easily to measuring in the process of their diagnostics, running and control. To meet the challenge it is necessary to resort to optoelectronics in order to effect relevant control over the current in stator and rotor coils, temperature of both coils, machine vibrations, air gap, and bearing of the machine under diagnostics.

General tests of electric machines require that a large number of auxiliary devices should be connected to the electric motor which is being tested. This encumbers to a considerabale extent the procedure of diagnostics especially when the motor is running.

The paper reviews a feasible method of automated flaw detection and visual control whereby various defects and flaws in the tested electric machine are possible to detect without any use of instruments such as brakes and sesnors, which are usually connected to the machine, and also of electrical and mechanical parameters. Readings obtained by this method are best combined with the readings obtained in analyzing signals resulting from a signal spreading in a solid noise medium. In this way it would be possible to detect and recognize a large group of mechanical flaws as well as some flaws in the bearings. By using digital classifiers it will be well possible to detect various electromechanical distortions and deviations from the normal mode of operation which, consequently, may cause serious corruption of both electrical and physical parameters of the object. These parameters are compared with model parameters corresponding to a particular aspect and mode of operation. The quality of these parameters will largely depend on the reference (preset) parameters.

A new type of system for diagnostics is introduced which employs highly error sensitive filter : Systematization of parameters is based on the selection of model and methods applied to the tested object. Using this new approach will lead to a novel method of classifying damage parameters. Based on the classical methods in time and frequency range, a new approach should be established for evaluation of defects in bearings, air gap, as well as some other flaws which correspond to these defect parameters.

Evaluation of these detected flaws is supported by additional measurements made by alternative means on general type of electric motors.

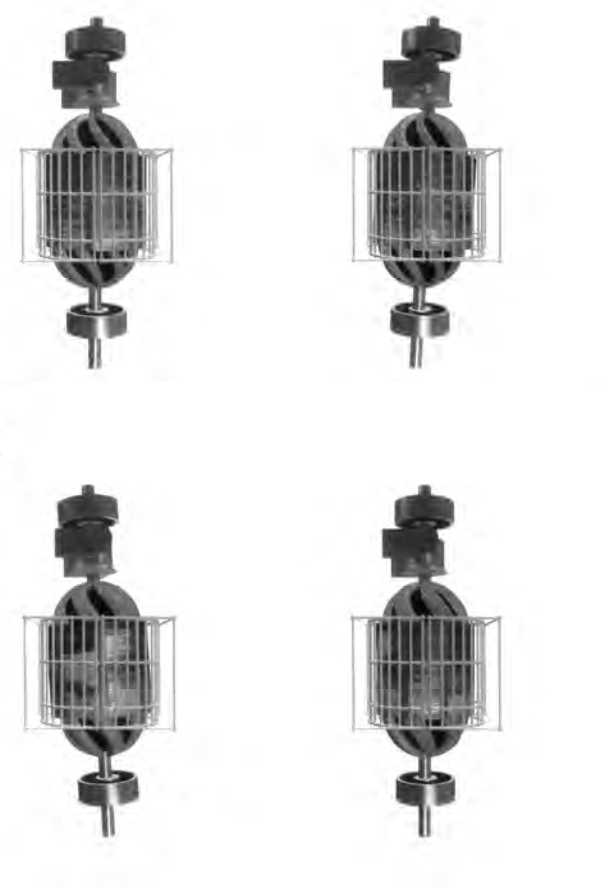

fig. 1

Fig 1 presents results based on 3D modeling by means of which information obtained through optoelectronic elements is visualized.The figure helps to properly analyze moments of displacement and rotation of the rotor in relation to the stator. Based on that analysis it is possible to determine the air gap and the level of arcing(in commutator machines). Selected objects are transformed into 3Ds with appropriate scaling and change of the object in relation to time. This approach allows annimation of serial frames with regard to time.

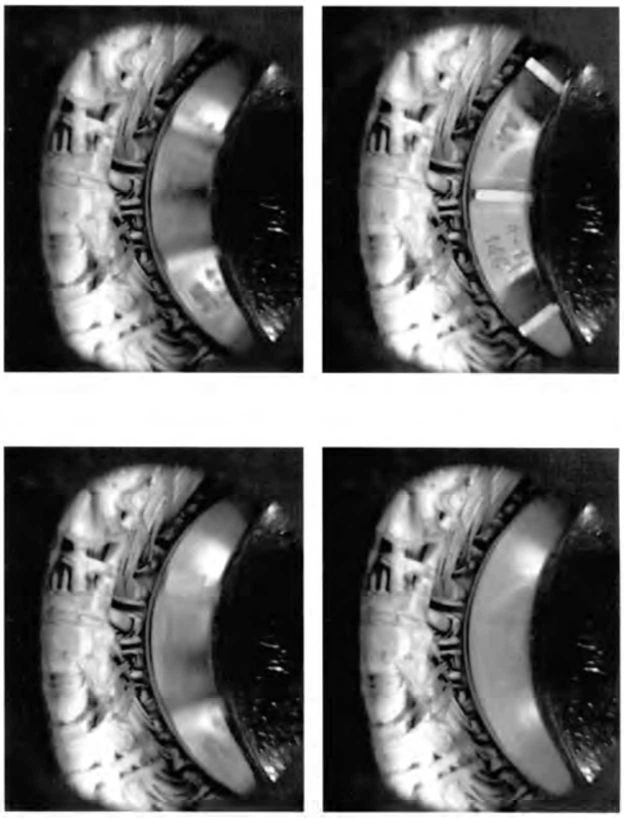

fig. 2

Fig .2 presents a digital image of the change in the air gap of the tested machine both in turning and stationary state. The author has used his CCD colour camara. Photos display different positions of the movable part. Readings obtained by this measurement are processed by proper software

CONCLUSION

So far diagnostics of electro-mechanical objects has been based largely on the experience of control experts. In order to avoid the impact of human factor and ensure objective outcomes it is necessary to employ automated diagnostic tests.Diagnostics approaches revealed in this paper involve methods of evaluation that are based on state of –the- art ways of obtaining relevant information. They are not confined solely to the data concerning the original cause for the flaws because problems with system's sensitivity are already eliminated by digital filters. Objects of display are based on experimental results and moreover appear as problematic when a certain malfunction is to be properly identified. By classifying these results , it is possible to spot electric or mechanical malfunctions by means of a cost effective system for diagnostics.

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