

Motor Current Signature Analysis and its Applications in Induction Motor Fault Diagnosis

Neelam Mehala, Ratna Dahiya

Abstract—The Motor Current Signature Analysis (MCSA) is considered the most popular fault detection method now a day because it can easily detect the common machine fault such as turn short ckt, cracked/broken rotor bars, bearing deterioration etc. The present paper discusses the fundamentals of Motor Current Signature Analysis (MCSA) plus condition monitoring of the induction motor using MCSA. In addition, this paper presents four case studies of induction motor fault diagnosis. The results show that Motor current signature analysis (MCSA) can effectively detect abnormal operating conditions in induction motor applications.

I. INTRODUCTION

Induction motors are a critical component of many industrial processes and are frequently integrated in commercially available equipment and industrial processes. Motor-driven equipment often provide core capabilities essential to business success and to safety of equipment and personnel. There are many published techniques and many commercially available tools to monitor induction motors to insure a high degree of reliability uptime. In spite of these tools, many companies are still faced with unexpected system failures and reduced motor lifetime. The studies of induction motor behavior during abnormal conditions and the possibility to diagnose these conditions have been a challenging topic for many electrical machine researchers. The major faults of electrical machines can broadly be classified as the following [1]:

- Stator faults resulting in the opening or shorting of one or more of a stator phase windings.
- Abnormal connection of the stator windings.
- Broken rotor bar or cracked rotor end-rings.
- Static and/or dynamic air-gap irregularities.
- Bent shaft (akin to dynamic eccentricity) which can result in a rub between the rotor and stator, causing serious damage to stator core and windings.

In recent years, intensive research [3-7] effort has been focused on the technique of monitoring and diagnosis of electrical machines and can be summarized as follows.

- Time and frequency domain analysis.
- Time domain analysis of the electromagnetic torque and flux phasor.
- Temperature measurement, infrared recognition, radio frequency (RF) emission monitoring.
- Motor current signature analysis (MCSA)
- Detection by space vector angular fluctuation (SVAF)
- Noise and vibration monitoring.
- Acoustic noise measurements.
- Harmonic analysis of motor torque and speed.
- Model, artificial intelligence and neural network based techniques.

Of all the above techniques, MCSA is the best possible option: it is non-intrusive and uses the stator winding as the search coil; it is not affected by the type of load and other asymmetries.

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Motor Current Signature Analysis And Its Applications In:

Current Signature Analysis for Condition Monitoring of Cage Induction Motors William T. Thomson, Ian Culbert, 2016-12-12 Provides coverage of Motor Current Signature Analysis MCSA for cage induction motors This book is primarily for industrial engineers It has 13 chapters and contains a unique data base of 50 industrial case histories on the application of MCSA to diagnose broken rotor bars or unacceptable levels of airgap eccentricity in cage induction motors with ratings from 127 kW 170 H P up to 10 160 kW 13 620 H P There are also unsuccessful case histories which is another unique feature of the book The case studies also illustrate the effects of mechanical load dynamics downstream of the motor on the interpretation of current signatures A number of cases are presented where abnormal operation of the driven load was diagnosed Chapter 13 presents a critical appraisal of MCSA including successes failures and lessons learned via industrial case histories The case histories are presented in a step by step format with predictions and outcomes supported by current spectra and photographic evidence to confirm a correct or incorrect diagnosis The case histories are presented in detail so readers fully understand the diagnosis The authors have 108 years of combined experience in the installation maintenance repair design manufacture operation and condition monitoring of SCIMs There are 10 questions at the end of chapters 1 to 12 and answers can be obtained via the publisher *Current Signature Analysis for Condition Monitoring of Cage Induction Motors* serves as a reference for professional engineers head electricians and technicians working with induction motors To obtain the solutions manual for this book please send an email to pressbooks@ieee.org William T Thomson is Director and Consultant with EM Diagnostics Ltd in Scotland Prof Thomson received a BSc Hons in Electrical Engineering in 1973 and an MSc in 1977 from the University of Strathclyde He has published 72 papers on condition monitoring of induction motors in a variety of engineering journals such as IEEE Transactions USA IEE Proceedings UK and also at numerous International IEEE and IEE conferences He is a senior member of the IEEE a fellow of the IEE IET in the UK and a Chartered Professional Engineer registered in the UK Ian Culbert was a Rotating Machines Specialist at Iris Power Qualitrol since April 2002 until his very untimely death on 8th September 2015 At this company he provided consulting services to customers assisted in product development trained sales and field service staff and reviewed stator winding partial discharge reports He has co authored two books on electrical machine insulation design evaluation aging testing and repair and was principal author of a number of Electric Power Research Institute reports on motor repair Ian was a Registered Professional Engineer in the Province of Ontario Canada and a Senior Member of IEEE [Proceedings of the UNified Conference of DAMAS, IncoME and TEPEN Conferences \(UNified 2023\)](#) Andrew D. Ball, Huajiang Ouyang, Jyoti K. Sinha, Zuolu Wang, 2024-05-28 This volume gathers the latest advances innovations and applications in the field of condition monitoring damage assessment and maintenance engineering as presented by leading international researchers and engineers at the UNified Conference of DAMAS International Conference on Damage Assessment of Structures IncoME International Conference on Maintenance

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on motor repair Ian was a Registered Professional Engineer in the Province of Ontario Canada and a Senior Member of IEEE

Advanced Condition Monitoring and Fault Diagnosis of Electric Machines Irfan, Muhammad, 2018-09-14 The reliability of induction motors is a major requirement in many industrial applications It is especially important where an unexpected breakdown might result in the interruption of critical services such as military operations transportation aviation and medical applications Advanced Condition Monitoring and Fault Diagnosis of Electric Machines is a collection of innovative research on various issues related to machinery condition monitoring signal processing and conditioning instrumentation and measurements and new trends in condition monitoring It also pays special attention to the fault identification process While highlighting topics including spectral analysis electrical engineering and bearing faults this book is an ideal reference source for electrical engineers mechanical engineers researchers and graduate level students seeking current research on various methods of maintaining machinery

Condition Monitoring and Faults Diagnosis of Induction Motors Nordin Saad, Muhammad Irfan, Rosdiazli Ibrahim, 2018-07-11 The book covers various issues related to machinery condition monitoring signal processing and conditioning instrumentation and measurements faults for induction motors failures new trends in condition monitoring and the fault identification process using motor currents electrical signature analysis It aims to present a new non invasive and non intrusive condition monitoring system which has the capability to detect various defects in induction motor at incipient stages within an arbitrary noise conditions The performance of the developed system has been analyzed theoretically and experimentally under various loading conditions of the motor Covers current and new approaches applied to fault diagnosis and condition monitoring Integrates concepts and practical implementation of electrical signature analysis Utilizes LabVIEW tool for condition monitoring problems Incorporates real world case studies Paves way a technology potentially for prescriptive maintenance via IIoT

Applied Computer Sciences in Engineering Juan Carlos Figueroa-García, German Hernández, Diego Fernando Suero Pérez, Elvis Eduardo Gaona García, 2024-10-17 The two volume set CCIS 2222 and 2223 constitutes the proceedings of the 11th Workshop on Engineering Applications WEA 2024 which took place in Barranquilla Colombia during October 23 25 2024 The 42 full papers presented here were carefully reviewed and selected from 97 submissions The papers are organized in the following topical sections Part I Artificial Intelligence Part II Optimization Simulation Applications

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Tech Notes, 1990 **Proceedings** Vibration Institute (Clarendon Hills, Ill.). Meeting, 1998 Fault Diagnosis

and Failure Prognosis of Electrical Machines Syed Sajjad Haider Zaidi,2010 *Condition Monitoring of Machinery Using Motor Current Signature Analysis* ,1989 Motor current signature analysis MCSA is a powerful monitoring tool for motor driven equipment that provides a nonintrusive means for detecting the presence of mechanical and electrical abnormalities in the motor and the driven equipment including altered conditions in the process downstream of the motor driven equipment It was developed at the Oak Ridge National Laboratory as a means for determining the effects of aging and service wear systems but it is applicable to a broad range of machinery MCSA is based on the recognition that an electric motor ac or dc driving a mechanical load acts as an efficient and permanently available transducer by sensing mechanical load variations large and small long term and rapid and converting them into variations in the induced current generated in the motor windings These motor current variations are carried by the electrical cables processes as desired Motor current signatures obtained in both time and over time to provide early indication of degradation Successful applications of MCSA technology patent applied for include not only motor operated valves but also pumps of various designs blowers and air conditioning systems Examples are presented briefly and speculation regarding the applicability of MCSA to a broader range of equipment monitoring and production line testing is also given 1 ref 13 figs **InTech** ,2000-07 Government Reports Announcements & Index ,1991 *Transport Phenomena in Rotating Machinery: Dynamics I* ,1998 *Electrical & Electronics Abstracts* ,1997 **Sensors and Control Systems in Manufacturing** Sabrie Soloman,1994 This text provides detailed coverage of the full range of sensors in use today including microwave laser photoelectric and inductive proximity sensors It uses state of the art sensory and control technology to boost the productivity of any manufacturing enterprise At the Crossroads ,1994 **IEEE International Electric Machines and Drives Conference Record** ,1997 **IAS '94** IEEE Industry Applications Society. Meeting,1994 **Proceedings of ... International Conference on Power Electronics and Drive Systems** ,2005

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