

Electrical Machines Diagnosis

WEMDCD focuses on state of the art research activities related to electrical machines and drives from both industry and academia

Mass production companies have become obliged to reduce their production costs and sell more products with lower profit margins in order to survive in competitive market conditions. The complexity and automation level of machinery are continuously growing. This development calls for some of the most critical issues that are reliability and dependability of automatic systems. In the future, machines will be monitored remotely, and computer-aided techniques will be employed to detect faults in the future, and also there will be unmanned factories where machines and systems communicate to each other, detect their own faults, and can remotely intercept their faults. The pioneer studies of such systems are fault diagnosis studies. Thus, we hope that this book will contribute to the literature in this regard.

Condition monitoring of electrical machines and drive systems is a vital factor to achieve efficient and profitable operation of a large variety of industrial processes. Similarly, parameter estimation is important for the machine designer, and invaluable to the operator of modern drives implementing various types of controllers. It is also necessary to know the machine parameters for a number of simulation purposes. The chapters in this volume cover recent trends and advances in these and other areas, including sections on on-line and off-line parameter estimation of smooth-air-gap and salient-pole electrical machines, their diagnosis, and condition monitoring. New real-time monitoring devices, vibroacoustic techniques, and the symptoms and possible causes of failures of electrical machines are also discussed. In the book a unified and in-depth physical and mathematical analysis of the various parameter estimators and condition monitoring methods is presented. For this purpose, where possible, space phasor theory is utilized and the most recent and modern developments in the field are incorporated. The book is intended for academic and professional electrical engineers, and all those responsible for the performance, maintenance, and design of electrical machines and drive systems.

Rotating electric machines, Electric machines, Electrical equipment, Synchronous machines, Induction motors, Electric motors, Diagnostic testing, Electrical faults, Electrical measurement, Magnetic field measurement, Windings, Rotors (electric), Stators, Bearings, Electric current Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives An insightful treatment of present and emerging technologies in fault diagnosis and failure prognosis In Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives, a team of distinguished researchers delivers a comprehensive exploration of current and emerging approaches to fault diagnosis and failure prognosis of electrical machines and drives. The authors begin with foundational background, describing the physics of failure, the motor and drive designs and components that affect failure and signals, signal processing, and analysis. The book then moves on to describe the features of these signals and the methods commonly used to extract these features to diagnose the health of a motor or drive, as well as the methods used to identify the state of health and differentiate between possible faults or their severity. Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives discusses the tools used to recognize trends towards failure and the estimation of remaining useful life. It addresses the relationships between fault diagnosis, failure prognosis, and fault mitigation. The book also provides: A thorough introduction to the modes of failure, how early failure precursors manifest themselves in signals, and how features extracted from these signals are processed A comprehensive exploration of the fault diagnosis, the results of characterization, and how they used to predict the time of failure and the confidence interval associated with it A focus on medium-sized drives, including induction, permanent magnet AC, reluctance, and new machine and drive types Perfect for researchers and students who wish to

study or practice in the area of electrical machines and drives, Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives is also an indispensable resource for researchers with a background in signal processing or statistics.

WEMDCD has now set the tradition of an international workshop where up to date research activities in electrical machines and drives are presented. A characteristic trend from previous WEMDCD conferences has been an increasingly strong industrial participation, which allows for enhanced exchanges between academia and industry. Conference Organisation: 2 Day Conference, 3 key note speeches, 6 oral sessions, 2 poster sessions, Industrial Exhibition. Sessions to cover: Electrical Machine Design and Modelling, Electrical Drives and their Control, Electrical Drives Reliability and Monitoring, Industrial and Transport Applications of Machines and Drives.

This book presents the main advanced signal processing techniques for fault detection and diagnosis in electromechanical systems. It focuses on presenting these advanced tools from time-frequency representation and time-scale analysis to demodulation techniques, including innovative and recently developed approaches.

Master the art of vibration monitoring of induction motors with this unique guide to on-line condition assessment and fault diagnosis, building on the author's fifty years of investigative expertise. It includes: *Robust techniques for diagnosing a wide range of common faults, including shaft misalignment and/or soft foot, rolling element bearing faults, sleeve bearing faults, magnetic and vibrational issues, resonance in vertical motor drives, and vibration and acoustic noise from inverters. *Detailed technical coverage of thirty real-world industrial case studies, from initial vibration spectrum analysis through to fault diagnosis and final strip-down. *An introduction to real-world vibration spectrum analysis for fault diagnosis, and practical guidelines to reduce bearing failure through effective grease management. This definitive book is essential reading for industrial end-users, engineers, and technicians working in motor design, manufacturing, and condition monitoring. It will also be of interest to researchers and graduate students working on condition monitoring.

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.

This book is an introduction to the concepts and developments of emerging electric machines, including advances, perspectives, and selected applications. It is a helpful tool for practicing engineers concerned with emerging electric machines and their challenges and potential uses. Chapters cover such topics as electric machines with axial magnetic flux, asynchronous machines with dual power supply, new designs for electrical machines, and more.

Up-to-date and system-oriented, this is a comprehensive, unified guide to possible faults in electromechatronic systems. It encompasses techniques for fault analysis, diagnostics, condition monitoring methods, reconfiguration, remedial operating strategies and fault tolerance in electrical machines, power electronics and key types of drives. It also covers remnant life estimation. A vital resource for researchers and professionals specialising in the design,

development and application of electrical machines and power electronics. An insightful treatment of present and emerging technologies in fault diagnosis and failure prognosis In *Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives*, a team of distinguished researchers delivers a comprehensive exploration of current and emerging approaches to fault diagnosis and failure prognosis of electrical machines and drives. The authors begin with foundational background, describing the physics of failure, the motor and drive designs and components that affect failure and signals, signal processing, and analysis. The book then moves on to describe the features of these signals and the methods commonly used to extract these features to diagnose the health of a motor or drive, as well as the methods used to identify the state of health and differentiate between possible faults or their severity. *Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives* discusses the tools used to recognize trends towards failure and the estimation of remaining useful life. It addresses the relationships between fault diagnosis, failure prognosis, and fault mitigation. The book also provides: A thorough introduction to the modes of failure, how early failure precursors manifest themselves in signals, and how features extracted from these signals are processed A comprehensive exploration of the fault diagnosis, the results of characterization, and how they used to predict the time of failure and the confidence interval associated with it A focus on medium-sized drives, including induction, permanent magnet AC, reluctance, and new machine and drive types Perfect for researchers and students who wish to study or practice in the rea of electrical machines and drives, *Fault Diagnosis, Prognosis, and Reliability for Electrical Machines and Drives* is also an indispensable resource for researchers with a background in signal processing or statistics.

Methods of diagnosis and prognosis play a key role in the reliability and safety of industrial systems. Failure diagnosis requires the use of suitable sensors, which provide signals that are processed to monitor features (health indicators) for defects. These features are required to distinguish between operating states, in order to inform the operator of the severity level, or even the type, of a failure. Prognosis is defined as the estimation of a systems lifespan, including how long remains and how long has passed. It also encompasses the prediction of impending failures. This is a challenge that many researchers are currently trying to address. *Electrical Systems*, a book in two volumes, informs readers of the theoretical solutions to this problem, and the results obtained in several laboratories in France, Spain and further afield. To this end, many researchers from the scientific community have contributed to this book to share their research results.

The aim of this second Workshop on Electrical Machines Design, Control and Diagnosis (WEMDCD) is to give an insight into emerging new techniques related to electrical machines design, control and diagnosis Despite the long standing market place of industrial electrical machines, they are still key components for

modern systems using, producing or transforming electricity
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Performances of the PCA Method in Electrical Machines Diagnosis Using Matlab. In one complete volume, this essential reference presents an in-depth overview of the theoretical principles and techniques of electrical machine design. This timely new edition offers up-to-date theory and guidelines for the design of electrical machines, taking into account recent advances in permanent magnet machines as well as synchronous reluctance machines. New coverage includes: Brand new material on the ecological impact of the motors, covering the eco-design principles of rotating electrical machines An expanded section on the design of permanent magnet synchronous machines, now reporting on the design of tooth-coil, high-torque permanent magnet machines and their properties Large updates and new material on synchronous reluctance machines, air-gap inductance, losses in and resistivity of permanent magnets (PM), operating point of loaded PM circuit, PM machine design, and minimizing the losses in electrical machines> End-of-chapter exercises and new direct design examples with methods and solutions to real design problems> A supplementary website hosts two machine design examples created with MATHCAD: rotor surface magnet permanent magnet machine and squirrel cage induction machine calculations. Also a MATLAB code for optimizing the design of an induction motor is provided Outlining a step-by-step sequence of machine design, this book enables electrical machine designers to design rotating electrical machines. With a thorough treatment of all existing and emerging technologies in the field, it is a useful manual for professionals working in the diagnosis of electrical machines and drives. A rigorous introduction to the theoretical principles and techniques makes the book invaluable to senior electrical engineering students, postgraduates, researchers and university lecturers involved in electrical drives technology and electromechanical energy conversion.

Monitoring and diagnosis of electrical machine faults is a scientific and economic issue which is motivated by objectives for reliability and serviceability in electrical drives. This book provides a survey of the techniques used to detect the faults occurring in electrical drives: electrical, thermal and mechanical faults of the electrical machine, faults of the static converter and faults of the energy storage unit. Diagnosis of faults occurring in electrical drives is an essential part of a global monitoring system used to improve reliability and serviceability. This diagnosis is performed with a large variety of techniques: parameter estimation, state observation, Kalman filtering, spectral analysis, neural networks, fuzzy logic, artificial intelligence, etc. Particular emphasis in this book is put on the modeling of the electrical machine in fault situations. Electrical

Machines Diagnosis presents original results obtained mainly by French researchers in different domains. It will be useful as a guideline for the conception of more robust electrical machines and indeed for engineers who have to monitor and maintain electrical drives. As the monitoring and diagnosis of electrical machines is still an open domain, this book will also be very useful to researchers.

With success of ICEEE 2010 in Wuhan, China, and December 4 to 5, 2010, the second International Conference of Electrical and Electronics Engineering (ICEEE 2011) will be held in Macau, China, and December 1 to 2, 2011. ICEEE is an annual conference to call together researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in Electrical and Electronics Engineering along with Computer Science and Technology, Communication Technology, Artificial Intelligence, Information Technology, etc. This year ICEEE is sponsored by International Industrial Electronics Center, Hong Kong. And based on the deserved reputation, more than 750 papers have been submitted to ICEEE 2011, from which about 98 high quality original papers have been selected for the conference presentation and inclusion in the "Electrical and Electronics Engineering" book based on the referees' comments from peer-refereed. We expect that the Electrical and Electronics Engineering book will be a trigger for further related research and technology improvements in the importance subject including Power Engineering, Telecommunication, Integrated Circuit, Electronic amplifier, Nanotechnologies, Circuits and networks, Microelectronics, Analog circuits, Digital circuits, Circuits design, Silicon devices, Thin film technologies, VLSI, Sensors, CAD tools, Molecular computing, Superconductivity circuits, Antennas technology, System architectures, etc.

With countless electric motors being used in daily life, in everything from transportation and medical treatment to military operation and communication, unexpected failures can lead to the loss of valuable human life or a costly standstill in industry. To prevent this, it is important to precisely detect or continuously monitor the working condition of a motor. *Electric Machines: Modeling, Condition Monitoring, and Fault Diagnosis* reviews diagnosis technologies and provides an application guide for readers who want to research, develop, and implement a more effective fault diagnosis and condition monitoring scheme—thus improving safety and reliability in electric motor operation. It also supplies a solid foundation in the fundamentals of fault cause and effect.

Combines Theoretical Analysis and Practical Application Written by experts in electrical engineering, the book approaches the fault diagnosis of electrical motors through the process of theoretical analysis and practical application. It begins by explaining how to analyze the fundamentals of machine failure using the winding functions method, the magnetic equivalent circuit method, and finite element analysis. It then examines how to implement fault diagnosis using techniques such as the motor current signature analysis (MCSA) method, frequency domain method, model-based techniques, and a pattern recognition scheme. Emphasizing the MCSA implementation method, the authors discuss robust signal processing techniques and the implementation of reference-frame-theory-based fault diagnosis for hybrid vehicles. *Fault Modeling, Diagnosis, and Implementation in One Volume* Based on years of research and development at the Electrical Machines & Power Electronics (EMPE) Laboratory at Texas A&M University, this book describes practical analysis and implementation

strategies that readers can use in their work. It brings together, in one volume, the fundamentals of motor fault conditions, advanced fault modeling theory, fault diagnosis techniques, and low-cost DSP-based fault diagnosis implementation strategies.

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.

Discusses the hypotheses for the research works are: 1. It is possible to capture the irregular conditions due to faults of the electrical machines by utilising a generalised mathematical model of the electrical machine. 2. It is also possible to derive a complete mathematical model of the machine that takes the operating conditions obtained from the experiments conducted on such a machine into consideration. It is believed that when such complete equations are solved, it will be able to produce expected signals. 3. It may be possible that the data from experiment can be used to test the techniques developed and methods considered for fault diagnosis. The expense of electrical machine repairs and refurbishing might not be substantial. However, the cost associated with down time is enormous. Thus, a system that provides early detection of machine deterioration, would prevent costly damage or failure and unsafe operation. Such a system is important to minimise the downtime and optimise the maintenance schedule of the machine. The faults in other types of electrical machines were not involved in this research work. The research work was limited to winding faults associated with induction machines.

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