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An Effectual Review on Fault Detection and Classification in Induction Motor

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ABSTRACT

Induction motors are operating as the support system for each industry. But like every different machine, due to serious duty cycles, poor operating atmosphere, installation and manufacturing factors, they gradually slow down or sometime fail.That's why, diagnosis methods that are competent to sense the motor failures are necessary in order to increase the safety and the performances of with increasing needs for reliability and efficiency, the field of fault analysis in induction motor. Three stage Induction motor is the major running part in the Industries and is the most applied electrical machines.And so detection of faults within the motor is incredibly necessary so as to enhance the performance of the induction motor, avoid the production lost and additionally to minimize the operational prices. The finite part analysis and the additionally associated numerical models symbolize not solely a contemporary technology of induction motor computer-assisted style and optimization however also a robust and really capable orientation within the analysis and detection of various faults related to the motor operation.

Keywords: Sources of Machine Faults, Internal Faults, External Faults,Non Destructive Analysis, Motor Current Signature Analysis

1. INTRODUCTION

Induction motors are the foundation for each trade. But like every different machine, they will finally fail serious duty cycles, poor operating surroundings, installation and manufacturing factors, etc. The induction motor is subjected to major types of fault and connected secondary faults. Figure 1 (a) classifies the sources of induction motor error. In Figure 1(b), the inner fault tree is delineated and Figure 1(c) represents the external fault tree for an induction motor[5].

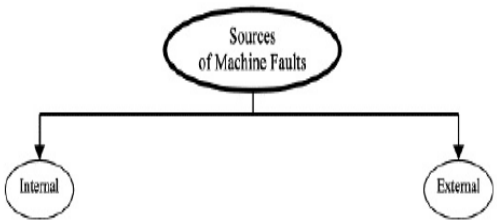

Figure1:(a) Sources of Machine Faults

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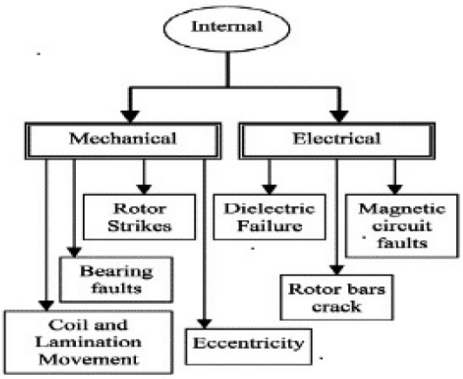

Figure 1: (b) Block Diagram Presentation of Internal Faults

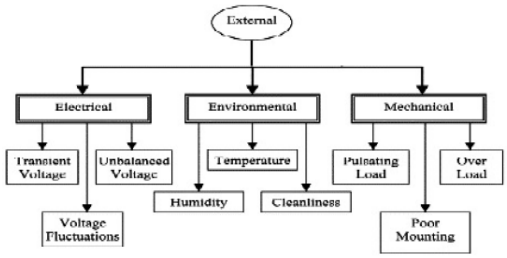

Figure 1: (c) Block Diagram illustration of External Faults

2. RELATED WORK

Paulo CezarMonteiroet al. [1]the analysis of defects with the study of magnetic flux has been assumed for equipment manufactures of the machine monitoring region. Through preliminary studies already some advantages have been found in relation to the traditional techniques of current analysis, as for example, not necessity of knowledge of the motor load, the number of bars and slots for the finding of turn-to-turn short circuit in the stator. This work considers the exploration of this technique for the finding of electric faults in three-phase induction motors. Theoretical and practical aspects, as well advantages and benefits of the method considered are discussed from the application of this method in the analysis of faults generated in a workbench of tests, collected by an electric motor of 5 CV, 4 poles and controllable mechanical load.MehranMirzaei et al.[2]gives analytical model of axial air gap induction motors with solid rotors that embody the two-dimensional current distribution within the rotor. The model is quasi-three-dimensional and considers the circumferential also as radial and angular dimensions. The technique is suitable for each constant current and constant voltage sources.OndrejVitek et al.[3] deals with the study of external magnetic flux of three-phase induction motor so as to diagnose the air gap imbalance caused by eccentric rotor. Dynamic eccentricity generates low frequency air gap flux parts, but they'll be discovered in stator current solely underneath mixed eccentricity. In contrast

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to MCSA (motor current signature analysis), delineated methodology permits to discover strictly dynamic eccentricity or to discover dynamic eccentricity underneath mixed eccentricity with a smallest result of static eccentricity. The amplitudes of characteristic frequency components foreseen applying FEM and a few obtained results are confirmed by measuring. Both strictly dynamic and mixed eccentricity is considered similarly saturation of magnetic circuit due to its important influence on calculated spectrum.Ramesh V et al. [4]a (NDA) Non Destructive Analysis of three stage induction machine fault finding has been talked about. The induction machine prototype was outlined utilizing Finite Element Analysis (FEM) based CAD programming. Stator Inter turn fault is composed by shortcircuiting the turns with current restricting resistor. The Flux Signature Analysis likewise has been done and contrasted with MCSA. Both the investigation is improved the situation with different load conditions with various fault seriousness. The fault recurrence magnitude at different fault conditions are computed and organized. This cost less NDA technique will be the best for machine fault diagnosis. Partha Sarathee Bhowmik et al.[5]dive into the different faults and investigation of traditional strategies for enlistment motor faults with a distinguishing proof of future research zones.Remus Pusca et al.[6]manages the limited component examination and trial thinks about concerning the impact of the broken bar and rotor dynamic unpredictability faults on the attractive field outside a squirrel-confine enlistment engine. The spatial conveyance of the attractive field, the time variety of the attractive transition thickness at a point outside the machine and the time variety of the electromotive power conveyed by a loop sensor are assessed in light of the limited component models of the solid and defective conditions of the engine Aziz Derouich et al.[7]actualizes a V/f control for induction machine continuously. An examination of the outcomes by recreation and analysis for, speed reactions, motion and streams of the genuine machine, with a DSPACE card and model built up by traditional distinguishing proof (Direct Current test , blocked-rotor test, no-heap test , synchronous test), to guarantee the legitimacy of the set up display. The scalar controlled enlistment engine permits task of the engine with the most extreme torque by synchronous

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activity on the recurrence and abundance of the stator voltage, with protection of the proportion V/f.MohdAfaqueIqbal et al.[8]for productive motors, numerous exploration approaches and proposals have been given by specialists in past. Different parameters like as stator/rotor space variety, size and state of stator/rotor openings, stator/rotor winding setup, decision of center material and so forth have huge effect on machine plan. Rotor opening geometry impacts the appropriation of the attractive field to some extent. Three kinds of rotor opening setups are planned and reproduced with various rotor space arrangement and rotor bars structure by changing the rotor opening design of base model.T. Vaimann et al.[9]presents the limited component demonstrating of three-stage squirrel-confine enlistment engine with broken rotorbar issues. Limited component display in light of a genuine machine isconstructed;spread of broken rotor bar fault and itsinfluence on the attractive transition thickness circulation of themachine confine is watched. As the proliferation of the fault will result in absolute breakdown of the enlistment machine rotor, if the fault isn't distinguished and explained, need of condition monitoring is brought up. Investigation of the fault and its influence tothe attractive field in the rotor confine and additionally changes in the phase voltage range are exhibited.Zheng Liu et al.[10]proposes another non-intrusive load checking technique in light of giant magnet resistance (GMR) motion sensors to follow stray motion spilling from acceptance engines. Limited component investigation (LCI) is connected to dissect stray transition highlights of test machines. In spite of the traditional strategies for estimating stator as well as rotor voltage and current, the proposed strategy measures the dynamic attractive field at particular areas and gives time-range highlights (e.g. spectrograms), reaction time load and stator/rotor qualities.Adam Warzecha et al.[11]manages principle impacts happening in transition linkages of the stator winding and analogous effects happening in charging streams of enlistment engines whose rotor centers have certain anisotropic properties. Expository structures which characterize spectra of the transition linkages have been given based on estimateof the attractive field co-vitality work. An arrangement approximating the symmetrical components of stage transition linkages was determined and deciphered. Consequences of

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field computations, completed forthe centers, were utilized to decide the impact of the anisotropy on the co-vitality capacity of the rotatingmagnetic field and elements of the motion connected with the winding.TongshanDiao et al.[12]double rotor changeless magnet acceptance motor(DRCMAM) is concentrated to enhance execution of normal enlistment motor(IM). Two-dimensional limited component display for DRCMAM is built up by Maxwell Ansoft programming, and electromagnetic characters of that were analyzed.Based on the turning coordinate framework, the scientific model concerning DRCMAM, execution bends under the diverse load are acquired. The last recreation investigation comes about are in great concurrence with the hypothetical anticipating comes about, which can be utilized to bear the cost of a hypothetical premise to plan the DRCMAM later on. Ielyzavetaet al. [13]the identification and arrangement of flaws in acceptance engine utilizing engine current mark examination and checking of stray flux are introduced. Amid the exploration engines with static, dynamic and blended whimsy were estimated. The outcomes were dissected and compared with the information acquired from the reenacted engine models. The conduct of sidebands of key space music was analyzed. The outcomes are presented as charts that show the adequacy and preferred standpoint of the strategy for analysis of the engine and identification of shortcomings in it.Ch. V. N. Raja et al.[14]Straight Induction engines (LIM) are utilized broadly in mechanical applications, particularly in transportation frameworks. These applications require high effectiveness with high power factor. Chiefly LIM experience the ill effects of two noteworthy disadvantages, low powerfactor and low proficiency. These downsides cause high vitality utilization and high information current. A novel Harmony Search streamlining calculation is proposed to meet required effectiveness and power factor in the plan of a Linear Induction Motor. Limited Element Method is embraced to dissect the motion thickness in LIM.R Chandralekha et al.[15]a novel method in light of the stray motion estimation diverse positions around the electrical machines is proposed. The principle goal of the proposition is to recognize the issues in acceptance engine because of electrical and mechanical root by vibration examination.

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Introduce another way to deal with discover the rotor bar disappointments.

Table 2.1 various fault detection techniques

Fault Detection Techniques	Detected Faults
MCSA	Bearing, Rotor, Stator and Vibration Faults
Park's Transform	Bearing and Stator Faults
Artificial Neural Networks	Bearing and Rotor Faults
Modal Analysis Method	Vibration Faults
Zero Crossing Time Method	Stator Faults
Vibration Testing and Analysis	Bearing and Vibration Faults
Concordia Transform	Bearing Faults
Multiple Reference Frames Theory	Eccentricity
KU Transformation Theory	Stator Faults

Table 2.2 Comparison of various optimization results

Method	Slip	Pole pitch (mm)	Convergence time (sec)
Interior Point algorithm (IPA)	0.13	48.2463	14
Genetic Algorithm (GA)	0.1495	48.0000	8.165
ParticleSwarm Optimization (PSO)	0.1495	48.0671	4.239

CONCLUSION

Expert frameworks can be utilized for fault determination utilizing rules got from the connection weight of an administered neural system and rules removed from heuristic learning. This mix of Artificial Neural Networks and expert learning may upgrade the observing framework for analysis.A novel Harmony Search improvement algorithm is utilized to meet mandatory proficiency and power factor in

the plan of a Linear Induction Motor. Finite Element scheme is embraced to study the flux thickness in LIM with the parameters got utilizing HSA.Multi-target advancement strategies were used for streamlined measurements of a linear induction engine to meet required proficiency and power factor at the same time.Itis observed that, the usage of GA(Genetic algorithm) have resulted in an efficiency of 67.9%.The PSO algorithm yielded an efficiency of 68.9% with a power issue of 11.57% less than the required. The FSA(Flux Signature Analysis) method will be suitable for all types of load but in Practical case which should have high costly flux sensor. So the (Motor current signature analysis)MCSA technique is the best and economic one. The finite Element study based (NDA) Non Destructive Analysis and cost less method will be the finest for Analysis of Machine Fault finding.

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