

“INDUCTION MOTOR ROTOR FAULT ANALYSIS USING AI TECHNIQUE”

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Abstract: Image processing technique is used in Automatic fault detection technique which play an important role in maintenance process. The maintenance before fault will be more economic and increase safety for human being as well as machine. In this paper we are using clustering- based image processing for broken rotor fault diagnosis. The main symptom of rotor fault has created special noise in running time, accuracy in decreasing order and vibration in running time. Because of this condition some time results will be missed or late. Therefore, we can apply image processing technique. When one or more rotor bars get damaged, then it will release a noticeable change in a spectrum. Raw signal of spectrum converted from feature to decision information. This information used to classify the image or the problem can it.

Key Words- Artificial Intelligence, Centroids, Cluster, Induction Motors, Rotor broken Fault, Image processing, Spectrum Analysis.

I Introduction

We cannot see electricity by necked eyes but we realize it in the form of heat, power, sound or others. Motor current signature Analysis is a technique that is used to analysis different fault spectrum. The use power analyzer to measure the quality of electrical network or Electrical Machine. Power quality analyzer

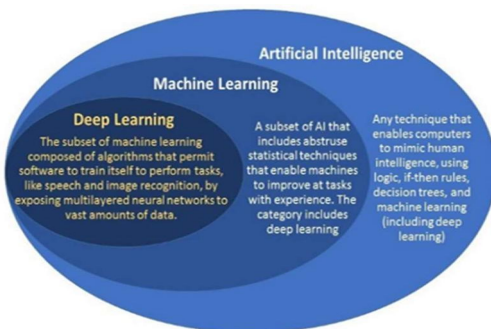


Fig 1: Building a Deep Learning Model

All data like voltage, current and power also value like harmonics, dips, swells, peaks and transients.[1]

To analysis the stator current, bearing fault and balanced or unbalanced condition will monitoring

to find out the data set. Some of approaches have been develop.

A. Decision Making- In these techniques we refer to the condition where we know or to assume the all-possible cases of the density function for each section. These kinds of parameter not clearly identify mean and variance. Before using these techniques, we must evaluate the values of the constant.[3]

B. Deep learning Model- Now a days we will get more accurate value using deep learning technique and algorithms. Synthesis design are broken down into many of small patterns. C. But the deep learning method applies several models for connecting neurons, including stacked automatic encoder (SAE), deep belief networks (DBN), convolution neural networks (CNN) and recurrent neural networks (RNN). Deep Structured learning is mainly functional for a variety of purposes in data scientist, Machine Design, video games, medical treatment, natural language processing (NLP), and Industrial Automation.[7]

D. Artificial Neural Network-It is a method to re-create perception. This technique is based on continuously getting feedback from system. In this technique algorithm continuously compare the present data with the available reference data.[9]

E. Pattern recognition- It is distressed with the Auto and manual noting process or classification of article or events. In addition to the set of a samples used in the system design, often called the training set, a data set called the test set must also be provided for testing the system.[11]

II Introduction to Cluster Model

Generally continued use of electrical machines can cause wear or tear and many Parts are bound to be broken down. An induction motor is one of the most favorite motors of an industrialist because of a controlling and simple fit to most of the load conditions. Mainly four types of fault condition in induction motor electrical fault, magnetic fault and mechanical fault. different types of faults relieve different types of spectrums. Here we are using cluster concepts to analyze spectrum data.[11]

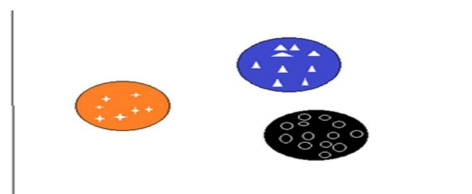


Fig:2 Sample of Clusters

A cluster can be thought of as a labeled group or class And quite analogous to the classified in classification but in an unsupervised manner the process of making clusters is known as clustering as shown in fig 2.

III Methodology

Lab view 2021 NXG 5.1 is one tool to diagnose the spectrum. This software is easily available in online forum. Power analyzer is used to get signals, Harmonics. Data

acquisition card PCI-6251 helpful to operate the power spectrum. Anaconda 3 software use for graph design and cluster design. For programming all data acquire by Lab view as well as power analyzer.

Firstly, a healthy motor spectrum stored after that faulty motor spectrum received. Then using anaconda 3 for all program will design like CSV file, centroid fixing etc.

Data of the induction motor observed by power analyzer at different rotor fault condition. we create a data set by analyzing the spectrum and prepare a CSV file. Then we design an algorithm and get a report in the form of a graph

Accomplishment of spectrum analysis can depend on harmonic component occurs due to fault.

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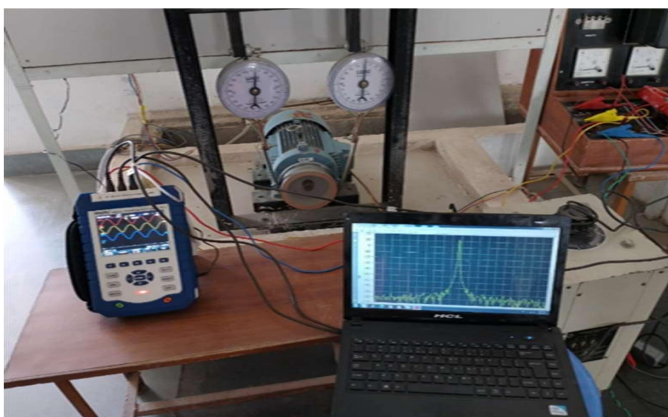


Fig:3 Experimental setup

3.1 Cause of Rotor Broken fault

We can observe many times that rotor of induction motor made by die casting method or copper bar technique. Therefore, Induction Motor generates asymmetries in spectrum. There are some reasons of fault occurs in Induction Motor.

1. Metallurgical stresses will be unequally distributed
2. Longitudinally slot occupation
3. Large centrifugal forces

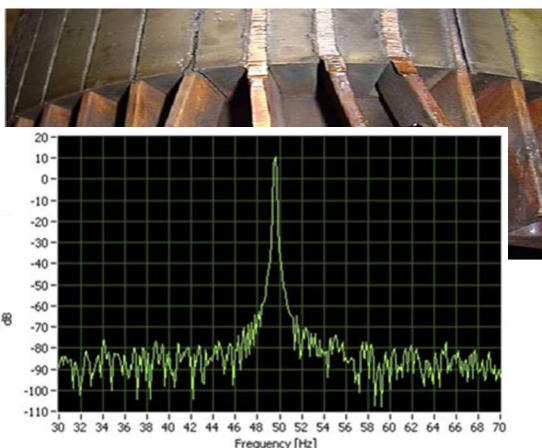


Fig:4 Broken Rotor Bar Fault

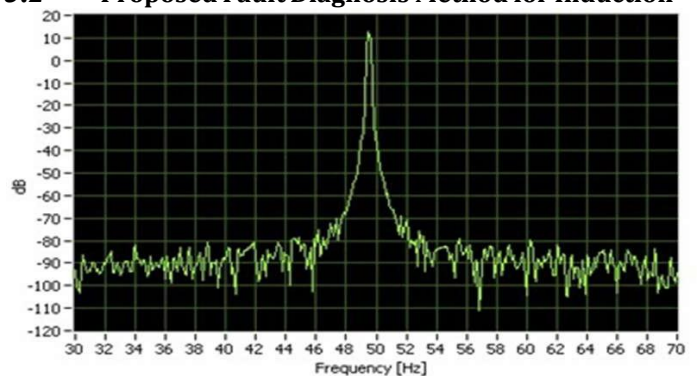
The need of prediction at an early stage so that maintenance schedule has been preplanned and motivate us to invented new methods to monitoring the conditions of motors and also indicate % of fault in easy way

Drawbacks of old methods: In random forest (RF) method. Researcher's use park vector approach

which one has combination of signal processing based on AI. Which is used for Rotor bar broken and inter turn short circuit fault. Draw backs of these methods are data collection problem. The fault data are not easy to gather by which data accuracy will be continuously decreases.[4]

To reduce the problem monitoring in online mode of rotor fault in AC rotating machine at running condition may be considered.

3.2 Proposed Fault Diagnosis Method for Induction Motors



Motors

Figure 5: Power spectrum of healthy motor at no load

The condition of Rotor fault has been tested on induction motor at different loading conditions.

We got spectrum at different stage like healthy condition and broken rotor bar condition. We observe changes between 30 to 70 hz

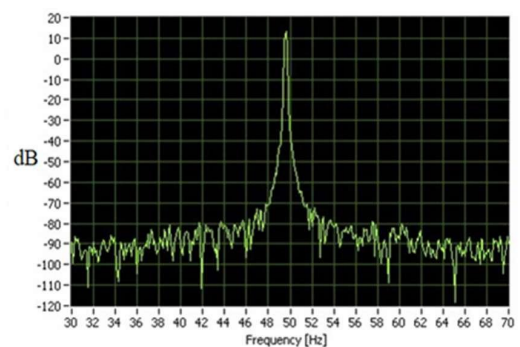


Figure 6: Power spectrum of faulty motor with 10% broken bar under no load condition

Figure 7: Power spectrum of faulty motor with more than 50% broken bar under no load condition

Failure of induction motors is a major issue in Industry. Hence many techniques are available to find out this faulty condition. In early days many researchers using motor current signature analysis to clarify the fault condition. Now a days

machine learning technique use in every field. Rotor Broken at end ring, 10%,30%, 50% of Rotor broken condition shown different spectrum. Analysis the different spectrum using cluster technique, image Processing technique.[2]

For ascertain the rotor fault, a structure arrangement has design. In first step stator current will sampled w.r.t. the power spectrum then observes the bandwidth variation and frequency component. These signals collected at different stage of damage rotor condition and comparing their DB with DB of healthy motors. Based on this variation we can show degree of fault in form of graph and cluster. In this model digitizing the data which has been obtain by the spectrum analysis.[1]

To identify a significant change that could be a indication of fault of Electrical Machine many technique has been applied like time domain analysis, frequency domain analysis, Time frequency domain analysis, Discrete wavelet Transform (DWT) and Time synchronous averaging (TSA) are

time taken process. They are based on stator current based fault detection. Drawback back of this technique is little bit time taken process.[3]

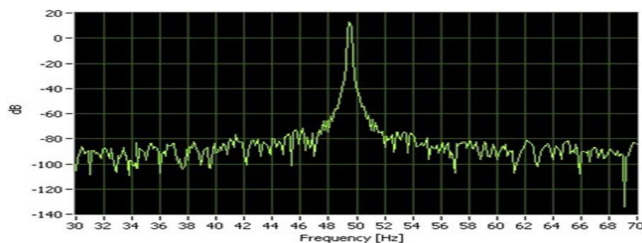


Figure 8: Power spectrum of healthy motor under half load condition

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In random forest (RF) method. Researcher’s use park vector approach which one has combination of signal processing based on AI. Which is used for Rotor bar broken and inter turn short circuit fault. Draw backs of these methods are data collection problem. The fault data are not easy to gather by which data accuracy will be continuously decreases.[4]

To reduce the problem monitoring in online mode of rotor fault in AC rotating machine at running condition may be considered. Now rotor fault measuring through vibration in motors running condition has been implemented. Reducing the Rotor fault from the total heat and spectrum of the induction motor. Hence this fault is split in two parts namely spectrum disturbance due fault or overloading. Above splitting would be observe of disturbance in machine. For known working hours of the motors, loading condition the cooling time and spectrum analysis the machine condition. Some data sets are used to train the cluster model. Once trained the cluster model designed then it would be tested using available data set. This cluster model can readily split in to the computation of category of fault. These data sets must be study one by one to dig up rotor fault Conforming to fact.[5]

IV System Representation using python programming

```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import seaborn as sns
import plotly.express as px

from datetime import datetime
from matplotlib.dates import date2num

%matplotlib inline
```

In this research paper all data set study in the form of HDB (Higher side Band width in DB) and LDB (Lower side Band width in DB) value. Firstly, to design algorithm model. We use python software and its complete library. Sample paragraph, The entire document should be in cambria font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes. The entire document should be in cambria font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes.

```
: import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv("F:\rama\5 rotor damage 09 march.csv")
df.plot()

plt.show()
```

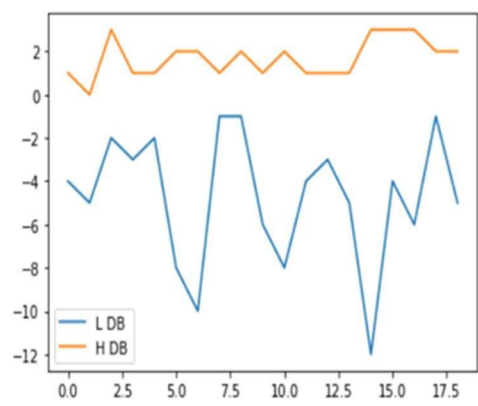


Fig 9: Damage Rotor Graph with Algorithm

The important data for us to look at are the HDB and LDB Value (DB) columns. Every 5 minutes, the Power Analyzer acquires a data point, stores it, and displays it to the user.

Next, we need to import all the relevant libraries. Today we’ll be using Pandas, NumPy,

Matplotlib, Seaborn, and Plot. these are the useful libraries for programming.

5 Rotor Damage Bars		Healthy Rotor Bars	
L DB	H DB	LDB	HDB
-4	1	-7	2
-5	0	-2	0
-2	3	-2	0
-3	1	-2	2
-2	1	-2	0
-8	2	-2	0
-10	2	-2	4
-1	1	-3	1
-1	2	-1	1
-6	1	-4	0
-8	2	-5	1
-4	1	-2	3

-3	1	-3	3
-5	1	-3	3
-12	3	-3	2
-4	3	-3	5
-6	3	-5	0
-1	2	0	0
-5	2	-7	3

Table 1: Healthy Rotor Data and faulty rotor data

In this case where one representative of each possible variation can be selected for each cluster. From the concept of physics, we know that centroid is the center point of mass where the object can be perfectly balanced. Using this concept, we some points in DB between 70 to 120 dB and compare this cluster variation. If more points get near to centroid 4,5,6. Then that fault belong to Rotor Fault. If load is reduced by rated value, then we get more dense result.

Figure 11: Fix centroids on Power spectrum of healthy motor at no load conditions

Algorithm 2-Centroid fixing

Figure 12: spectrum comparison using cluster

V Result and Discussion

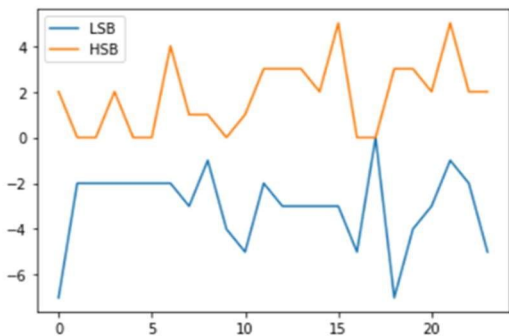
We can obtain data from power spectrum but before scanning we need to filter all data and drag out noise and harmonics. Which will improve the data quality. Using cluster algorithms technique spectrum has been divided in many classes. we have compared all class then dig out the result.

```

import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv("F:\\rama\\healthy motor.csv")
df.plot()
plt.show()

```



Since long time we were analysis the spectrum. In this paper we analysis this spectrum using two techniques first one graph analysis and another one is cluster technique. Both techniques

shown using diagram. Lastly, we get that cluster techniques give more better result than graph technique.

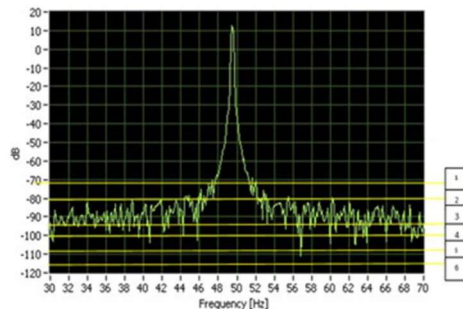
In case of damage rotor, we get some variation and dip points between 100 to 110 DB. But in case of half load, we notice frequent dip points between 100 to 110 DB. But in case of half load, we notice frequent dip points between 100 to 120 db.

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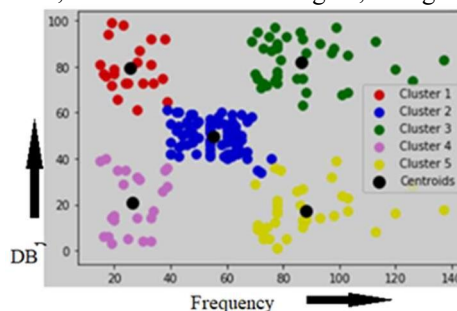
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