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Fault diagnosis of Induction Motor using Wavelet Transform and ANN techniques

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ABSTRACT

In this paper, the supply side fault identification of inverter fed induction motor is studied and SIMULINK model of the three-phase inverter fed induction machine is drawn. Using this mathematical model we are going to detect the number of faults like single phasing, three-line to ground fault, single phase to ground fault, double line to ground fault, etc,. To identify these type of faults we are going to use the Artificial Neural Network and Discrete Wavelet Transform techniques.

Keywords: ANN, DWT, Inverter fed Induction Motor, MATLAB/SIMULINK

I. INTRODUCTION

THE industries nowadays extensively use the AC drives such as induction motors, because of the rigidness, robustness and low maintenance cost. These are used only for constant speed applications. But the induction motors with power electronic devices like inverter is used for variable speed applications. It is assumed that over 38% of fault occurs in the system are due to the inverter system.

The most type of faults occurred in the supply side system of the induction motor are single phasing, single phase to earth, 3-phase to earth, etc,. With a view to prevent the occurrence of a fault, it is needful to identify the fault that has been occurred in the system.

There are 3-types of failures which may occur in the induction motor they are identified as - Electrical failure or faults, Mechanical failure or faults and Environmental failure or faults, etc, **N Hammad [2]** they provided the unique analytical tool to determine the various faults in the system. They detected the converter and inverter faults of induction motor in running mode.

The inverter is used to obtain the variable speed applications to the induction motor. This is normally controlled by IGBT switch. There are different methods used to detect the fault **Diallo [4]** use the concept of fuzzy logic to detect the faults and **Sanghoon Kim [5]** studied the signal processing algorithm method to diagnose various faults of induction motor.

II. SUPPLY SIDE FAULTS

1) Single Phasing

   If any one of the phases got disconnected or undergo any type of fault, then the other two phases will continue to supply the load. This may cause external pressure to the remaining 2 phases of the induction motor.

2) Single phase to earth fault

   When one of the three phases got disconnected, and it is in contact with the ground is called a single phase to earth fault.

3) Three-line to earth fault

   When all the three phases get disconnected and in contact with the ground is known as three phases to ground fault.

III. WAVELET TRANSFORM

Wavelet is a tiny portion of the waveform and Wavelet Transform is a mathematical function used in digital signal processing. There are 2 wavelet transforms-

(i) Continuous Wavelet Transform (CWT), and

(ii) Discrete Wavelet Transform (DWT).

In this paper we are using the DWT; in this, the wavelets are sampled discretely in nature. Compare to the Fourier transform WT produces the output signal in both frequency and time domain. It is used for Feature Extraction in this paper by analyzing the voltage and current waveforms. Using different properties like energy, entropy, kurtosis, skewness, etc, in the discrete wavelet transform and by converting the d-q axis to abc plane we used to extract the different features of current signals to identify and detect the fault in the system.

IV. ARTIFICIAL NEURAL NETWORK

The ANN is similar to the biological neural network in the human brain. It consists of several layers such as input layer, output layer, and hidden layer. It includes connecting units called as nodes or artificial neurons, these AN will carry weight in such a way that, it will automatically adjust itself as the learning proceeds. The main function of the ANN is to tackle challenges as the human brain would.

This will be trained according to a learning rule that is classified into- Supervised Learning and Unsupervised Learning. In Supervised learning manually training of the system is to be done by producing the specified output with the input, it is used in large networks.

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In Unsupervised learning, the network itself senses the inputs without getting any outside support. In this paper, we used a supervised learning method. This is used to detect and classify which form of fault or failure that has been experienced in the system. We used the nntool in SIMULINK to train the network with the featured DWT input signal.

We used Back Propagation neural network (BPN) method; in this the error is calculated among the specified outputs and obtained output, will be propagated back to the network to get the desired output. This is the advantage of the Back Propagation neural network.

V. SIMULINK MODEL

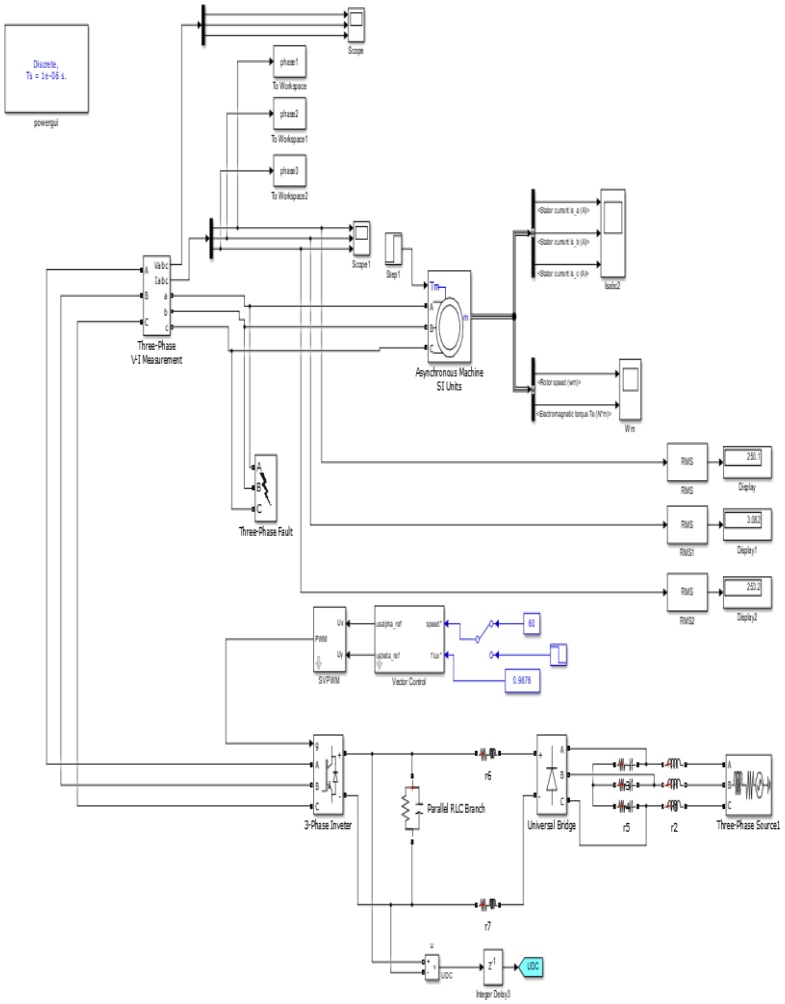

Fig.1 SIMULINK model of the inverter fed induction motor

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VI. SIMULATION RESULTS

1) Healthy Condition

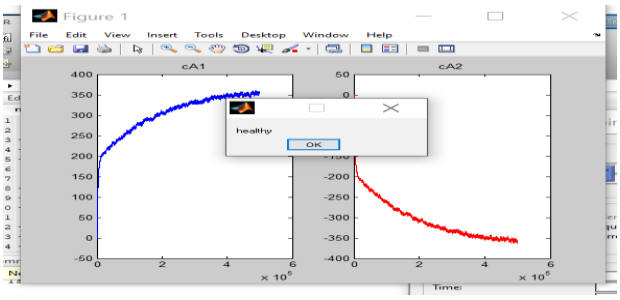

Fig.2 nntool display of the healthy condition

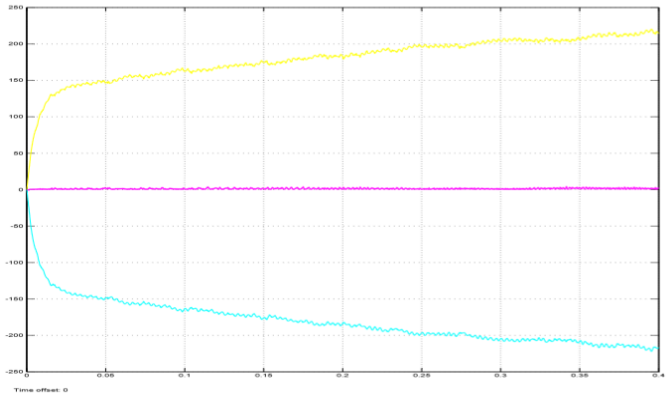

Fig.3 Stator currents of IM in a healthy condition

2) Single Phasing

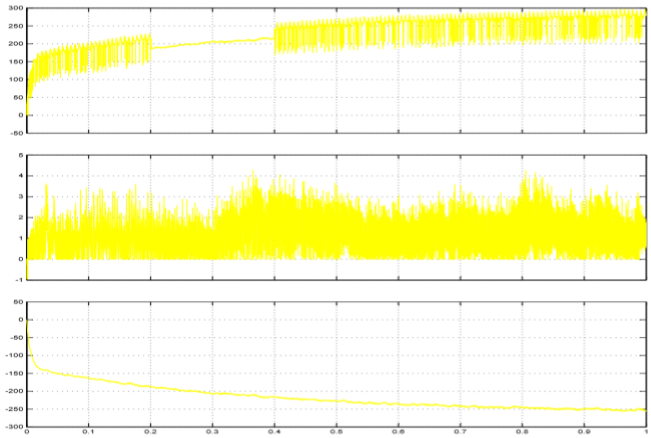

Fig.4 Stator current in single phasing

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3) Single line to Earth

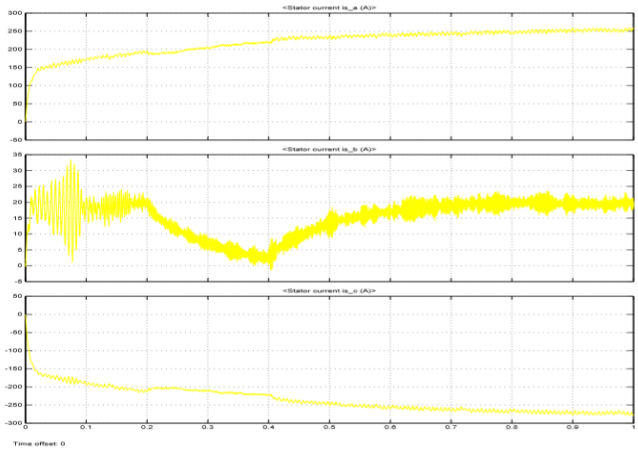

Fig.5 Stator current of a single line to Earth fault

4) Double line to Earth

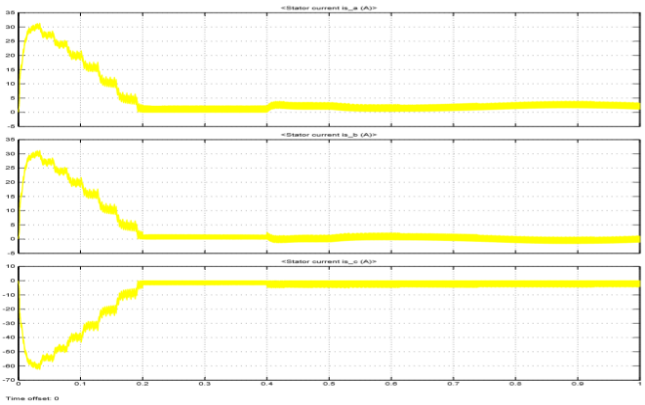

Fig.6 Stator current of a double line to Earth fault

5) Three phase to Earth

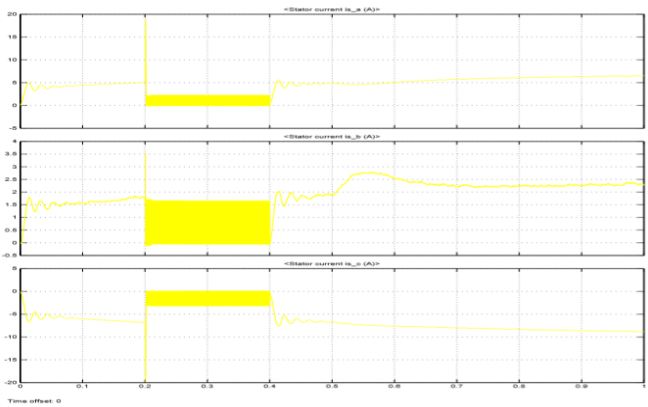

Fig.7 Stator current of a three phase fault

VII. CONCLUSION

An inverter fed induction machine is simulated using SIMULINK software and the different types of supply side faults are detected using Artificial Neural Network and Discrete Wavelet Transform. These techniques will provide the accurate results than other techniques in comparison. Further, it will display which type of fault that has occurred on the motor system.

VIII. ACKNOWLEDGEMENT

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