RESEARCH PAPER ON FAULT DETECTION IN CASCADE H-BRIDGE MULTILEVEL INVERTER USING ANN BASED ON WAVELET DECOMPOSITION

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Abstract

In this dissertation, we have developed a fault diagnosis and reconfiguration system for multi-inverter (MLID) drives using artificial intelligence-based techniques. MLID output phase voltages can be used as valuable information to diagnose faults and their location. It is difficult to diagnose an MLID system using a mathematical model because MLID systems have many switching devices and the complexity of the system is nonlinear. Therefore, neural network (NN) classification is used to diagnose a defect in the MLID system. Multilayer perceptron (MLP) networks are used to identify the type and location of errors that occur. Key component analysis (PCA) is used in the service extraction process to reduce the amount of NN input. The lower three-dimensional input space typically reduces the time required to teach the NN, and the reduced noise can improve the mapping performance. The genetic algorithm is also used to select key valuable components. The MLP neural network (NN), the main component neural network (PC-NN), and the selective primary component neural network (PC-GA-NN) are compared based on a genetic algorithm.

1. INTRODUCTION

Industrial modernization requires more power and existing solutions for high power supply interruptions from multi-inverters. Inverter is a device that converts dc to ac and increases the required power which is very important in utilizing renewable energy sources. For high-speed vehicles or large power drives and in hybrid vehicles, the multistage inverter is one of the most successful solutions. An H-bridge multi-inverter system with almost twice the maximum voltage is easier to build than to reduce accuracy and coherence to increase performance expectations. The cascaded inverter is capable of reducing voltage fluctuations and the same time fluctuations are suitable for use in knock-out communications in wind power. The conversion power is most vulnerable to the failed variable. Statistical studies show that about thirty-eight percent of interruptions in fast-moving progress are caused by electrical engine failures and fifty-three percent in motor vehicles [1]. Electrical sensors, capacitors and gate sensors are the most vulnerable components [5]. On the other hand, 60% of system failures can be caused by failure of soldering and printing of circuit boards [8]. In order to make any process efficient and stable, it is important to understand any errors that arise during operation in the shortest possible time. It demonstrates an intelligent method for detecting faults] for the capture of open and short faults in the power supply in an inverter-feed induction machine reaching a rated average value of 99.9%..

In order to maintain continuous use for a step-change system, knowledge of fault behavior, error prediction and fault diagnosis is required. Faults must be detected as soon as possible after they occur, because if the motor drive unit is running continuously under abnormal conditions, the drive or motor may fail quickly. Research on fault diagnosis in inverters was initially focused on voltage transformers, which will discuss several fault methods in this project [3]. These switchgear defects can be classified into open circuit breakers and short circuit breakers. Short circuit failure not only causes abnormal overcurrent in the energy trading system and generators, but it also causes some additional problems, such as depletion of synchronous generators. In this case, the entire system must be switched off immediately for safety reasons, but a failure of the circuit breaker does not require shutdown.

2. PROBLEM ANALYSIS

In this paper, a diagnostic and design process based on a neural network is performed by damaging a disc. The main advantage of wavelengths is that the electrostatic precipitate dissolves into the operating system. Eventually, the source of the transfer in the local region is identified using a floating object. In this work, a Dynamic Transformation System (DWT) is used which takes a special sample of the waves to show the identified characteristics. DWT can be divided into Mallet, Diagonal Filter, Raising Plan, and Codec Codes. The main advantage of changing the vibration is that the size of the window changes frequently, resulting in the best timing decisions. The wave switch checks the area and frequency several times at the same time. Wave changes are very useful for analyzing long, short-lived transient lines. Therefore, many wave-based systems for marking and questioning have been developed.

In this work, we describe the determination of errors based on the wavelength of the multiplier and the concept of the various conversion variables. Good work done on adapting various transformers and long range waveforms to remote pumping systems to produce signal quality. Network network technology is used to detect and detect conversion errors based on the extraction characteristics. An artificial neural network, or ANN, is a network system with many levels of regulation derived from human brain activity. The main advantage of ANN over other diagnostic methods is the change in performance based on learning and the ability to go to work immediately. In ANN, a neuron is identified that produces a substance that has the same output but also its multiple input. All the work is done in two forms, namely training and conditions of use.

3. PROPOSED WORK

3.1 Modelling And Simulation Of Cascaded Multilevel Inverters

The converters have to be designed to obtain a quality output voltage or a current waveform with a minimum amount of ripple content. In high power and high voltage applications the conventional two level inverters, however, have some limitations in operating at high frequency mainly due to switching losses and constraints of the power device ratings. Series and parallel combination of power switches in order to achieve the power handling voltages and currents. The conventional two level inverters produce THD levels around sixty percent even under normal operating conditions which are undesirable and cause more losses and other power quality problems too on the AC drives and utilities. For high voltage applications, two or more power switches can be connected in series in order to provide the desired voltage rating[5]. However, the characteristics of devices of the same type are not identical. For the same OFF state current, their OFF state voltages differ. Even during the turn OFF of the switches the variations in stored charges cause difference in the reverse voltage sharing. The switch with the least recovered charge faces the highest transient voltage. For higher current handling, the switches are connected in parallel, however because of uneven switch characteristics the load current is not shared equally. If a power switch carries more current than that of the others, then the power dissipation in it increases, thereby increasing the junction temperature and decreasing the internal resistance. This in turn increases its current sharing and may damage the devices permanently which is undesirable for critical applications. In the conventional two level inverters the input DC is converted into the AC supply of desired frequency and voltage with the aid of semiconductor power switches[11]. Depending on the configuration, four or six switches are used. A group of switches provide the positive half cycle at the output which is called as positive group switches and the other group which supplies the negative half cycle is called negative group. A detailed comparison is made between the conventional and multilevel inverter. The multilevel inverters perform power conversion in multilevel voltage steps to obtain improved power quality, lower switching losses, better electromagnetic compatibility and higher voltage capability. Considering these advantages, multilevel inverters have been gaining considerable popularity in recent years. In the recent past, the multilevel inverters have drawn tremendous attention in the field of high voltage and high power applications. In the researches on multilevel inverters, determination of their respecti ve control strategies is the emerging topic which has been discussed in the previous chapter. One of the most important problems in controlling a multilevel voltage source inverter is to obtain a variable amplitude and frequency sinusoidal output by employing simple control techniques[23]. Indeed, in voltage source inverters, non-fundamental current harmonics cause power losses, electromagnetic interference and pulsating torques in AC motor drives. Harmonic reduction can then be strictly related to the performance of an inverter with any switching strategy. In multilevel voltage source inverters.

3.2. Principle Of Operation Of Cascaded Multilevel Inverter.

A relatively new power converter structure, cascaded-inverters with separate DCsources is introduced here. This new converter can avoid extra clamping diodes or voltagebalancing capacitors. Figure 5.2 shows the basic structure of the cascaded inverters withSDC for three phase configuration. Each SDC is associated with a single phase full bridgeinverter. The AC terminal voltages of different level inverters are connected in series. The phase output voltage is synthesized by the sum of four inverter outputs. Each single-phase full bridge inverter can generate three level outputs, +Vdc, 0, and –Vdc[9]. This is madepossible by connecting the DC sources sequentially to the AC side via the foursemiconductor power devices. Each level of the full bridge converter consists of fourswitches. Using the top level as the example, by turning ON S1 and S4, yields V1 = +Vdc.By Turing ON S2 and S3, yields V1 = -Vdc. Turning OFF all switches yields Vdc = 0.Similarly, the AC output voltage at each level can be obtained in the same manner.Minimum harmonic distortion can be obtained by controlling the conducting angles ofswitches at different inverter levels.

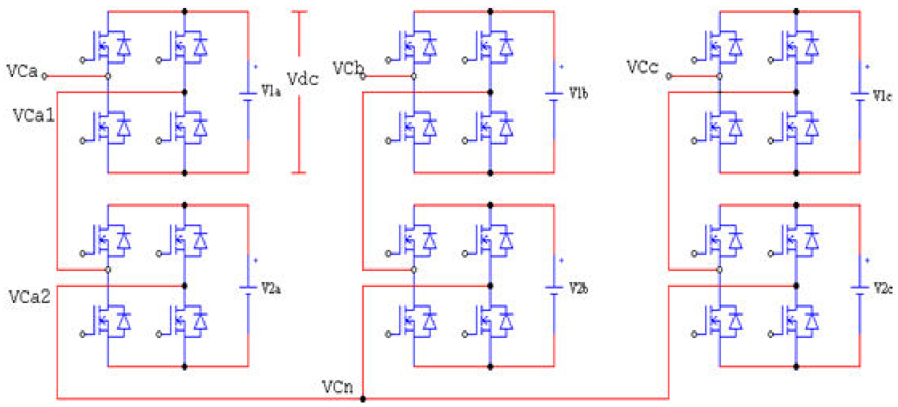

Fig. Three phase Y-configured cascaded inverter

The simulation work mainly focuses on

1. The comparison between different levels of three phase Cascaded Multilevel Inverters based on the proposed novel SVPWM technique discussed in the previous chapter.
2. The comparison is done on the basis of output Total Harmonic Distortion, fundamental and harmonic of the rms voltage and input DC utilization.
3. Simulation of single phase CMLI inverter is not presented since the proposed work mainly focuses on the three phase inverter for high power industrial drive applications.

The most important aspect which sets the cascaded H Bridge apart from other multilevel inverters is the capability of utilizing different DC voltages on the individual H bridge cells. In two level PWM, the switching frequency is always equal to the carrier frequency for modulation indices less than unity. In the multilevel PWM, the switching frequency can be less than or greater than the carrier frequency and is a function of the displacement angle between the carrier set and the modulation waveform[17]. The general structure of the multilevel converter is to synthesize a near sinusoidal voltage from several levels of DC voltages. As more steps are added to the waveform, the harmonic distortion of the output wave decrease, approaching zero as the number of levels increases.

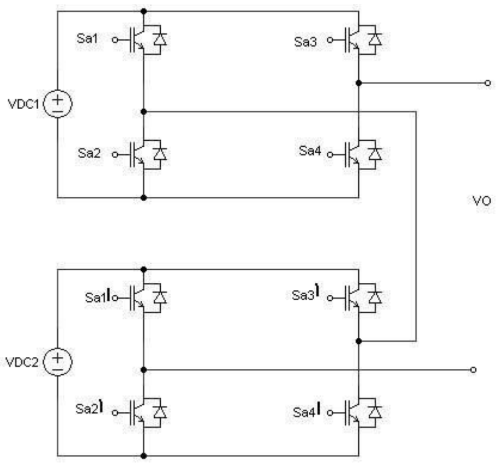

Figure 2 Structure of single phase three level cascaded multilevel inverter

4. RESULT AND DISCUSSION

Here to execute our idea we made the inverter Simulink model in the Matlab of version 2016a with configuration of operating system of computer is windows 10 pro version 1089 CPU @2.00Ghz, RAM 4GB system type 64 bit operating system x64 based processor. To get to be learnt the Neural Network you have to enter the number of hidden layer that has been used by neural network. We have to observed the error rate andexecution time for different hidden layers as we are using the operating system It took too much time to execute to by considering minimum error rate and execution time, we took 25 hidden layer Neural network is get to be learn according to the input data and targets. As there were to many samples are available so don't know that which is useful or not? For thatpurpose we have using wavelet decomposition technique that filter the whole data into temporary data and useful data. So it has been easy for us to check that useful data, after running the whole program its show the graph of decomposed and normal samples and also the configurations of Neural network.

Table: 4.1 normal and decomposed waveforms of Vout

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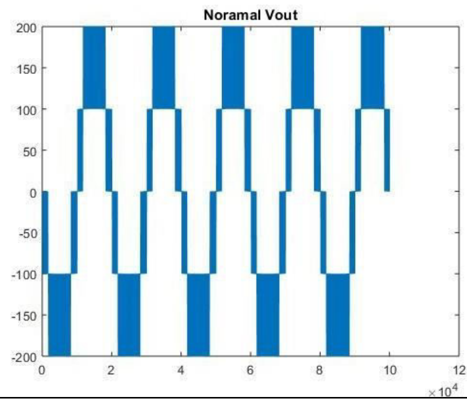
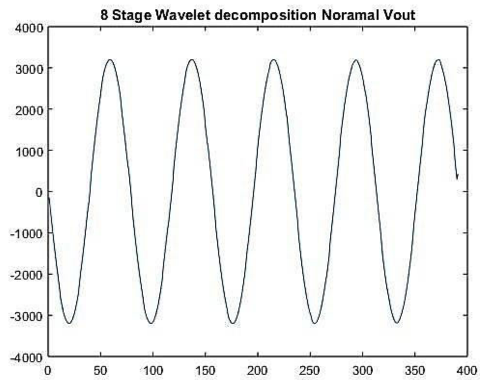
<tr><th>Normal Vout</th><th>Decomposed Vout</th></tr>
<tr><td>
</td><td>
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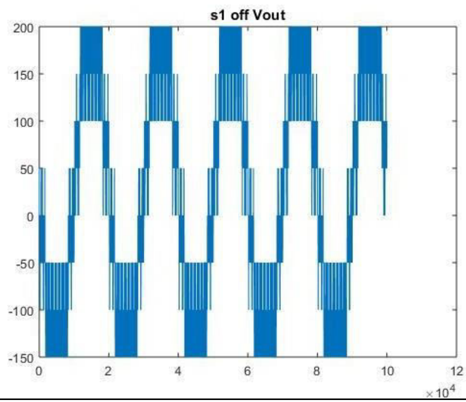
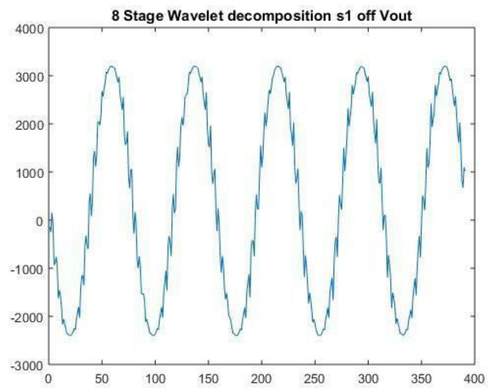
<tr><td>
</td><td>
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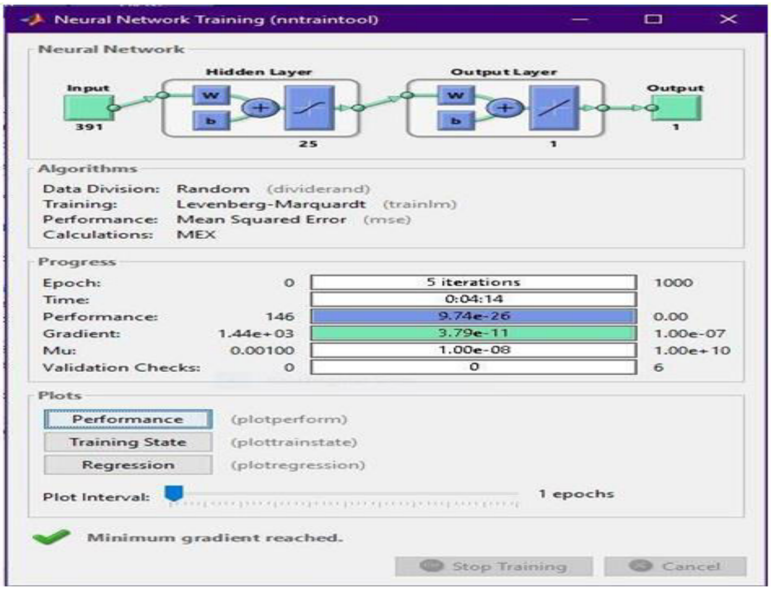

Fig. 4.2 Configuration of Neural Network Learning

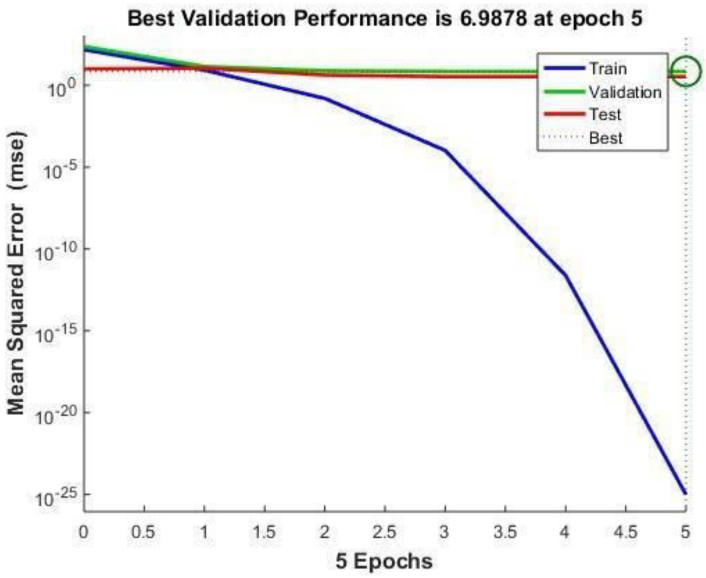

Figure 4.3: Performance Plot in Train Neural Network

The above figure is of performance plot in Neural Network Training, Generally the error reduces after mire epochs of the training, but might start to increase on validation dataset as network starts over fitting the training data. In the default setup the training stops after six consecutive increases in validation error, and the best performance is taken from with the epoch with the lowest validation error. After completion of the learning of Neural Network it shows the error rate and execution time is been require to get learn the Neural network. As for various hidden layer the error rate is different so have to continuously train the ANN till we get the minimum error rate. We have get error rate as small as possible so that ANN could Efficiently work and Give the accurate result the whole idea of the project is depend upon the ANN . Number of fault situation we can Take for Learning its totally depend on ourselves. If you have not specify the fault condition to ANN the it unable to detect the location of fault or its can say system is normal

5. CONCLUSION

Due to the increasing importance of multilingual inverters in medium and high power applications, many new topology with a reduced number of power elements and DC sources are proposed. The proposed work is envisioned in the environment of MATLAB SIMULINK. The simulation results validate the effectiveness of the proposed method for differentiating faulty components leading to future advances in hardware-based real-time fault detection in cascading H-Bridge inverters. This project proposes a multi-bridge H-bridge inverter with fault detection method. Fault cells can be detected and fault switch locations identified in cases of open and short faults using the proposed detection method. Using the trial and error method, we learn to test and validate samples and by reference to the algorithm, we create scenarios in real time and obtain accurate results based on them.

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