Dynamic performance evaluation of three phase induction motor using Multilayer Perceptron Neural Network and radial basis function Cascade neural network

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Abstract: Dynamic performance of induction motor field-oriented controllers strongly depends on model parameter accuracy. A parameter mismatch produces an error in field orientation and undesirable coupling between the flux and torque controllers. Although it is possible to determine in advance the model parameters, significant changes may take place during the normal operation which has to be compensated online. In the paper, induction motors dynamic performance are studied and detected with the use of cascade network of Radial Basis Function and Multilayer Perceptron neural network. Simple parameters like set of currents are taken as an input and fed to a cascade of Radial Basis Function and Multilayer Perceptron neural network(RBF-MLP-NN). Different parameters like Mean Square Error (MSE) are calculated and used for analysis of losses and hence faults.

Keywords: Currents, Faults, Induction Motors, Multilayer Perceptron, Neural Network

I. INTRODUCTION:

Artificial Neural Network (ANN) is a system based on the operation of biological neural networks; it is an abstract simulation of a real nervous system. ANN‘s have been applied with astonishing success in fields ranging from Computer science to Engineering to Medicine. In recent years, the most stimulating and profitable development is increasing usage of ANN in various areas of electrical machines and control. ANN‘s attempts to model the structure of the human brain and are based on self-learning. It is composed of a large number of highly interconnected processing elements called neurons working in unison to solve a particular problem. The structure is highly parallel, resulting in ability to self organizes to represent information and rapidly solve problems in real life

Radial basis functions are a type of functions which can be employed in any model i.e. Linear and non linear and any sort of network i.e. Single layer and Multilayer. But mostly RBF's have been associated in single layer neural network. In two layer neural network, RBF's are embedded such that each hidden unit implements a radial activated function. The output unit is the sum of all weighted hidden units. Due to non linear modeling, RBF's can be used in complex modeling.

Multi Layer perceptron (MLP) is a feed forward neural network with one or more layers between input and output layer. Feed forward means that data flows in one direction from input to output layer (forward). This type of network is trained with the back propagation learning algorithm. MLPs are widely used for pattern classification, recognition, prediction and approximation.

II. EXPERIMENT:

The basic outline of the proposed work is as follows: To develop an efficient integrated approach using soft computing tools for parameter estimation of induction motor. To evaluate model parameters of the induction motor using above developed approach. To validate the results obtained by soft computing techniques by its hardware implementation and Evaluation of model at different operating conditions.

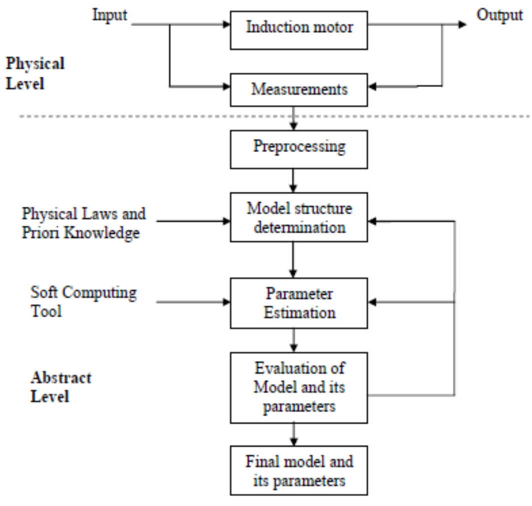

Fig 1: The Various stages of the proposed work

A three phase Induction Motor is used for the practical purpose. Experimental setup like no- load test and blocked rotor test are conducted for acquiring the set of data from healthy motor and faulty motor. Initially the readings are taken from a healthy motor and taken as reference. Then different set of readings are taken from faulty motor under different loads and three more sets of data are defined.

RBF neural network is a feed forward network whose structure is shown in Fig. 2. MLPNN and RNN are used but it has a drawback of not giving better identification performance so another neural network structure is studied and used i.e radial basis function neural network (RBFNN). A three-layer (input, hidden, and output layer) MLP network is used as shown in Fig. 2. The number of neurons in the input and output layers are set to 4 and 1 respectively, whereas the number of neurons in the hidden layer is usually decided by trial and error [1]. In general, the neuron number in the hidden should be moderate. Neither too few nor too many hidden layer neurons are expected because the former would cause the RBF- MLP network failure to learn from the training set and the latter may tend to memorize but cannot generalize the training set [2]–[3]. Furthermore, it has been suggested that one hidden layer is sufficient for any arbitrary classification problem, with ample hidden layer neurons [1]. Here we have selected the number of neurons to be 20.

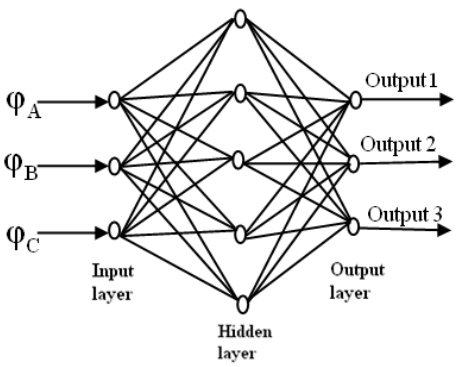

Fig.2 RBF-MLP NN Architecture

After a few training cycles, the MLP network is tested by an independent test set of healthy motor readings. The RBF-MLP network is considered trained when the output errors of the independent test set are adequately low.

III.RESULTS AND DISCUSSIONS:

Multilayer Perceptron -Radial Basis Function cascade Neural Network is designed by initially making all the weights set to some value some value. Input layers, output layers and hidden layers are calculated with the formula. In implementation, number of input layers is taken at 6, number of hidden layers as 4 and output is taken as 1. Ideal values are set as desired output and actual output is taken from the network. The error is calculated with the formula

Error e(r)= Desired output d(r)-Actual Output a(r)

From the readings after 100 iterations, we see that the accuracy of the network for fault detection of motor goes on increasing upto 90 percent i.e. it means that out of 100 faulty motor readings it can detect upto 90 faulty readings

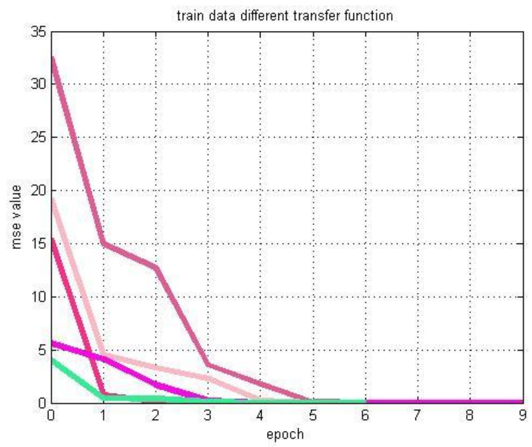

Fig.3 MSE value for different transfer functions of training data

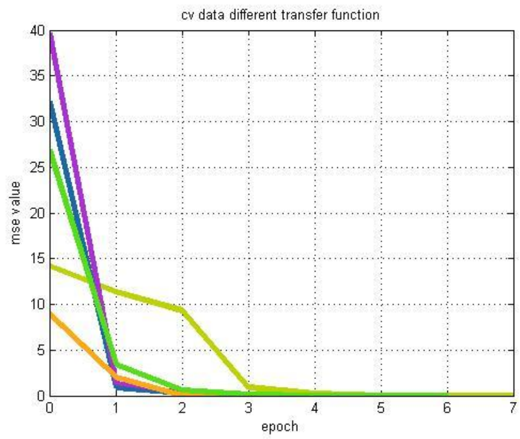

Fig.4 MSE value for different transfer functions of CV data

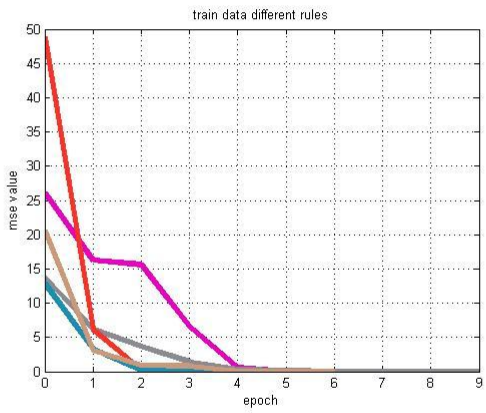

Fig.5 MSE value for different rules of training data

When the data currents of the faulty motor are grouped together and the MSE of the group is taken into consideration, the following graph is obtained. It helps us in detecting after what interval of time the losses are taking place. If the following graph is taken into consideration, it shows that there is a fluctuation in the cv data and the training data after an specific interval of 50 sec of running. The data is divided in 70% training data, 20% testing data and 10% cv data. CV data is used to cross verify whether the given data is tested with high efficiency.

REFERENCES:

1. IEEE transactions on components, packaging and manufacturing technology, vol. 1, no. 3, march 2011 application of extracted rules from a multilayer perceptron network to moulding machine cycle time improvement
2. S. Haykin, Neural Networks and Learning Machines . Upper Saddle River, NJ: Pearson, 2009, p. 169.
3. M. Negnevistsky,Artificial Intelligence . Reading, MA: Addison-Wesley, 2002, p. 174
4. M. T. Hagan, H. B. Demuth, and M. Beale, Neural Network Design Boston, MA: PWS-Kent, 1996, pp. 11–17.
5. D. W. Patterson, Artificial Neural Networks . Englewood Cliffs, NJ: Prentice-Hall, 1996, pp. 206–207.
6. R. J. Schalkoff, Artificial Neural Networks . New York: McGraw-Hill, 1997, pp. 209–210.
7. S. Kumar, Neural Networks . New York: McGraw-Hill, 2005, p. 99.
8. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Neuro-Fuzzy and Soft Computing . Englewood Cliffs, NJ: Prentice-Hall, 1997, pp. 235–236.
9. IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 12, NO. 6, NOVEMBER 2001 Sensitivity Analysis of ultilayer Perceptron to Input and Weight Perturbations Xiaoqin Zeng and Daniel S. Yeung , Senior Member, IEEE

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