A Review paper on Artificial Neural Network: A Prediction Technique

Mitali S Mhatre¹, Dr. Fauzia Siddiqui², Mugdha Dongre³, Paramjit Thakur⁴
¹Assistant Professor, Saraswati College of Engineering, Kharghar, India, mitalimhatre113@gmail.com
²Head & Associate Professor, Saraswati College of Engineering, Kharghar, India, fauzia.hoda@gmail.com
³Assistant Professor, Saraswati College of Engineering, Kharghar, India, mugdha.sonawane@gmail.com
⁴Assistant Professor, Saraswati College of Engineering, Kharghar, India, paramjit3010@gmail.com

Abstract: This paper presents a brief review of prediction technique- Artificial Neural Network (ANN). It is used to improve prediction accuracy of the model with less dependency on experimental data. The basic steps used in MATLAB are reported along with different ANN trainings. The purpose of the training is to minimize mean square error. ANN model can be used easily for prediction of output parameters which helps in optimum selection of machining parameters for the purpose of process planning and optimization of machining parameters.

Key words: Artificial Neural Network, LM Training algorithm

INTRODUCTION
ANN is an interconnected group of nodes, akin to the vast network of neurons in a brain. ANN are computational models inspired by animal’s central nervous systems (in particular the brain) that are capable of machine learning and pattern recognition. They are usually presented as systems of interconnected “neurons” that can compute values from inputs by feeding information through the network. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. There are certain advantages of ANN in general, a neural network can perform tasks that a linear output cannot.

When an element of the neural network fails, it can continue without any problem by their parallel nature. It can be implemented in any application. A neural network learns and does not need to be reprogrammed. So ANN is becoming popular for prediction of results about certain parameters. In machining processes ANN can be applied for prediction of response parameters from process parameters, once trained properly. Proper care must be taken while applying the ANN to these processes and needs training to operate. The architecture of a NN is different from the architecture of microprocessors therefore needs to be emulated. It requires high processing time for large neural networks [1].

LITERATURE SURVEY
Pradhan and Bhattacharya [2] demonstrated the use of RSM and ANN with back-propagation-algorithm-based mathematical modelling. They carried out the optimization of the machining characteristics of micro-EDM during the microhole machining operation on Ti-6Al-4V. The input parameters were utilized for developing the ANN predicting model. The performance measures for optimization were MRR, TWR, and overcut. They developed an ANN model with back-propagation neural network algorithm, which was trained with response values obtained from the experimental results. The Levenberg–Marquardt training algorithm has been used for a multilayer feed-forward network. From the analysis of ANN-predicted responses and experimentally obtained responses for multi-objective optimal input process variables settings, they found that the percentage of error is very small and is in an acceptable range. The developed ANN model for the micro-EDM process can be utilized to determine the combination of optimal process parameter settings for obtaining the best micromachining efficiency.

![Fig. 1 (a) Comparison of experimental and ANN predicted results of MRR](image1.png)
![Fig. 1 (b) Comparison of experimental and ANN predicted results of TWR](image2.png)

Fig. 1 (a) Comparison of experimental and ANN predicted results of MRR (b) Comparison of experimental and ANN predicted results of TWR [2]

Rao et al. [3] applied the hybrid model and performed optimization of surface SR in EDM using ANNs and genetic algorithm (GA). They conducted the experiments by varying the peak current and voltage and the corresponding values of SR were measured. Multi-perceptron neural network models were developed using Neuro Solutions software. GA concept is used to optimize the weighing factors of the network. There is considerable reduction in mean square error when the network is optimized with GA.
Atefi et al. [4] studied the influence of different EDM parameters such as pulse current, pulse voltage, pulse on-time, pulse off-time in finishing stage on MRR as a result of application copper electrode to hot work steel DIN1.2344. Full factorial experiments were chosen and statistical analysis has been carried out on MRR data gathered from the test. Appropriate ANN has been designed for the prediction MRR in finishing stage of hot work steel DIN1.2344. Finally for reducing the error in ANN, a hybrid model i.e. a combination of statistical analysis and ANN model has been designed.

Gao et al. [5] reported combination of ANN and GA to establish the parameter optimization model. They set up an ANN model with Levenberg-Marquardt algorithm represent the relationship between MRR and input parameters, and GA was used to optimize parameters, so that optimization results are obtained. The model is shown to be effective, and MRR is improved using optimized machining parameters. They concluded that the net has better generalization performance, and convergence speed is faster. GA was used to optimize parameters. MRR was improved by using optimized parameters. Fig. 2 shows regression analysis between train MRR and prediction.

Mathew et al. [7] reported on the development of modelling and optimization for micro EDM process. ANN was used for analysing MRR to establish the parameter optimization model. A feed forward neural network with back propagation algorithm was trained to optimize the number of neurons and number of hidden layers to predict a better MRR. They concluded that low value of RMSE results in increasing model accuracy. Choice of important factors within the manufacturing process is very important because these factors determine performance. The results indicated that ANN model can be successfully applied to predict the machining response.

Steps of ANN in MATLAB

Following are the basic steps of ANN used in MATLAB [8]

a. Collection of input-output dataset
b. Pre-processing of input-output dataset
c. Neural network design and training
d. Performance evaluation of the neural network.

a. Collection of input and output data set: Output values in response to the different experimental combinations of input parameters obtained from the experiments are chosen. The capability of ANN model to generalize data depends on several factors such as appropriate selection of input-output parameters of the system, the distribution of the input-output dataset and the format of the presentation of the input-output dataset to the neural network.

b. Pre-processing of input-output dataset: Feed forward back propagation, ‘newff’, is the network structure with a Levenberg-Marquardt backpropagation training function, ‘trainlm’, and a backpropagation weight and bias learning function, ‘learngdm’. A two-layer feed forward network is used as it can approximate any function with a finite number of discontinuities given sufficient neurons in the hidden layer. Samples obtained at the experimental stage were randomly divided into three groups to train (60% of the samples), validate (20% of the samples) and test (20% of the samples) the neural networks with a ‘dividerand’ data division function. Levenberg-Marquardt backpropagation algorithm automatically stops training when generalization ceases to improve, as an increase in the mean square error (MSE) of the validation samples indicates. Input processing functions used were ‘fixunknowns’, ‘removeconstantrows’ and ‘mapminmax’. Tansig/purelin is the transfer function of the ith layer:
Supervised or associative learning

Learning based solutions can be categorized as: change/adjust the weights according to some learning rule. learning patterns into the solution, and by letting the net 
priori knowledge) or the net can be trained by feeding 
otherwords, the weights can be set explicitly (utilizing a 
quantify the strengths of the connections can be applied. In 
direct or by using a relaxation process). Several methods to 
that the set of input data results into a desired output (either 

Unsupervised learning (self-organizing paradigm)

Where the net (output) unit is trained to respond to clusters 
of pattern within the input framework. In this paradigm, the 

Reinforcement Learning

In this method, the learning machine executes some action 
on the environment, and as a result, receives some feedback/response. The learning component grades its action (as either good or bad) based on the environmental response, and adjusts its parameters accordingly. Generally speaking, the parameter adjustment process is continued 
until an equilibrium state surfaces where no further 
adjustments are necessary.

An ANN reflects/represents a system of simple processing 
elements (neurons) that can exhibit complex, global 
behavior that is determined by the connections among the 
processing elements and the element parameters, 
respectively. Neural networks offer a number of 
advantages, including the ability to implicitly detect 
complex, nonlinear relationships among dependent and 
independent variables, the ability to detect all possible 
interactions between predictor variables, or the availability 
of multiple training algorithms. ANN based solutions have 
provided excellent results/insides into very complex 
problems in forecasting, data-mining, task scheduling, or 
optimized resource allocation problems.

REFERENCES