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Short Communication

PREDICTION OF MILLING MACHINE PARAMETER TO FORECASTE OUTPUT QUANTITY BY NEURAL NETWORK METHOD

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Abstract: The aim of this thesis is to discover the role of these parameters is to prediction in milling operations by using artificial neural networks and Taguchi design of experiment.The study was conducted by using milling machine with fine type carbide tool with twin cutting edge.Experimental data collected from tests were used as input parameters of a neural network to identify the sensitivity among machining operations, MRR and surface roughness. The experimental data is later used to predictoutput data by using artificial neural network. Neural network algorithms are developed for use as a direct modeling method, to predict MRR and surface roughness for end milling operations.

Keywords:-Milling Machine, Neural Network, Prediction, MRR and surface roughness.

Introduction

It is expected that the next decade machine tools will be intelligent machines with various capabilities such as prediction of self setup required parameters to reach to the best surface finishing qualities. Typically, surface inspection is carried out through manually inspecting the machined surfaces and using surface profilometers with a contact stylus. As it is a post-process operation, it becomes both time-consuming and labor-intensive. In addition, a number of defective parts can be found during the period of surface inspection, which leads to additional production cost. Milling process is one of the common metals cutting operations and especially used for making complex shapes and finishing of machined parts. The quality of the surface plays a very important role in the performance of the milling as a good quality milled surface significantly improves fatigue strength, corrosion resistance or creep life. Therefore the desired finish surface is usually specified and the appropriate processes are selected to reach the desired surface quality. Unlike turning, face milling or flat end milling operations, predicting surface roughness for ball end milling by mathematical models is very difficult. Researchers have used various intelligent techniques, including neural network, fuzzy logic, neuro-fuzzy, ANFIS, etc., for the

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prediction of machining parameters and to enhance manufacturing automation. A neural network with their learning capabilities can be used to learn the fuzzy decision rules, thus creating a hybrid intelligent system. A scientific approach to plan the experiments is a necessity for efficient conduct of experiments. When the problem involves data that are subjected to experimental error, statistical methodology is the only objective approach to analysis. Thus, there are two aspects of an experimental problem: the design of the experiments and the statistical analysis of the data. These two points are closely related since the method of analysis depends directly on the design of experiments employed. Modern rotating machines are susceptible to equipment malfunction and ambient disturbances because of their complexity and high speed. The complexity hampers the operator's ability to diagnose and eliminate equipment failures before their occurrence Fault diagnosis of rotating machinery has been done by analyses the external condition with the help of vibration signals to determine the internal fault in machines.

The machining process is used in both roughing and finishing operations. Such problems may be caused by several factors such as material, cutting speed, feed rate, cutting depth, and also the workers who have no expertise. The parameters that affect surface roughness include machining parameters and cutting tool properties etc.

The proposed method allows an experimental fault diagnosis using other techniques, such as back propagation transform, it works under different operational conditions, a different angular speed and torque transmitted. So, there is different forms of wavelet has been used to assess the condition of the machine. Here an approach for cutter and Arbor of milling machine fault detection, combining wavelet map is proposed.

Neural networks were developed to assist the programmer in his work. For the input into neural network, the cutting forces were chosen. Neural networks have the ability to distinguish and extract information from the complicated and intricate patterns. They are mainly used to search for patterns and detect trends that are too complex to be noticed by humans or other techniques. With the help of neural networks the answer on such a question can be quickly anticipated.The predicted results match 90 % including the residuals. Thus proves the neural network is used for optimization of geometric and machining parameters.[3]

Objective of Paper

The main objective of this work is to predict the total output parameter in face-milling operation. ANN model outperforms the prediction accuracy obtained by the ANN to best knowledge, the multiple-input multiple-output (MIMO) nonlinear relationship with back propagation-based ANN model. In this thesis, some experimental results are also given to make the comparison of effectiveness with those obtained by the Matlab toolbox in terms of prediction accuracy model with back propagation (BP) algorithm given by the Matlab toolbox. Experiments were conducted through the established Taguchi's design method. In this work, the machining characteristics are investigated based on surface roughness and tool wear. It is an important tool to identify the critical parameters and predict optimal setting of each parameter. The most appropriate strategy available to the manufacturers and researchers to reduce the possibility of such failures is to introduce some form of feedback representing the quality of machining and state of the tool during the machining process. In conventional large scale machining, the deformed chip thickness is generally much larger than the tool edge radius and, therefore, it is reasonable to assume that, as most cutting models do, the cutting tool has a sharp cutting edge and it completely removes the material as specified by the depth of cut. Analysis of variance is used to study the effect of process parameters and establish correlation among the cutting speed, feed and depth of cut with respect to the major machinability factor, cutting forces such as cutting force and feed force. Recently, a carefully designed and improved version of the optimization approach, which is a practical large scale implementation of Newton's method, was successfully applied to learning deep neural networks from random

initializations (Martens, 2010), which was considered to be infeasible with other optimization approaches until very recently. This thesis was inspired by the success of the HF approach on deep neural networks and was compelled to revisit the basic problem of NN training.

Material and Method

Artificial Neural Network is a capable computation model for a weight diversity of problems. For manufacturing process where no satisfactory analytic model exist or a low order empirical polynomial model is inappropriate, Neural networks offer a good alternative approach. Until today many different neural network models have been developed. They include perceptrons, Kohonen, Hassoun, Yuille, Hebbian, Oja, Hopfields, Back propagation and Kolmogorov Networks, to mention a few of the better known network models.

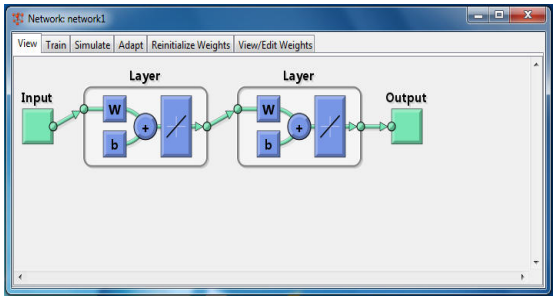

Fig. 4.1Created Neural Network

The optimal ANN architecture was designed by means of MAT Lab Neural Network toolbox. Neurons in the input layer correspond to depth of cut, cutting speed and feed rate. The output layer corresponds to surface roughness and delimitation. In this model, the inputs are fully connected to the outputs. Input and output layers have 4-36-2 neuron respectively. In the neural network model, the output neurons on the input layer reach the jth neuron on the next layer and become its input respectively.

The results are calculated in the decision tools suite 6.2 trial version software is an integrated set of neural tool used in optimization run on Microsoft excel. Neural network is a highly flexible modeling tool with the ability to learn the mapping between input and output parameters.In back-propagation neural network, the learning algorithmhas two phases. First, a training input pattern is presented tothe network input layer. The network then propagates theinput pattern from layer to layer until the output pattern isgenerated by the output layer.

Material Selection

Work Piece of MS material with Length of 100 mm, Width 60 and thickness of 10 mm has been selected for the experimental work. The reason behind the selection is, MS material are increasingly being used for different engineering applications because of their superior qualitative advantages include high ratio of strength to weight , high fracture strength and toughness , excellent thermal and corrosion resistance. For machining of MS material and advanced materials requiring high precision ofMRR and high surface finish, selection of tool to be widely processed and applicable in manufacturing industries.Here it is necessary to design the input parameters and there levels to develop surface roughness prediction model for end milling process as shown in Table 1

Table 1 Input Parameter and Levels

	Speed RPM	Feed mm/tooth	Depth of cut mm/tooth
Level 1	100	1	1.5
Level 2	120	1.2	2
Level 3	150	1.4	2.5
Level 4	180	1.6	3

Experiment Design

Design of experiments is a powerful analysis tool for modeling and analyzing the effect of process variable over some specific variable which is an unknown function of these process variables. The experimental design method isan effective approach to optimize the various machining parameters. The selection of such points in the design space is commonly called Design of Experiments (DoE) or ExperimentalDesign. Randomly chosen design points make an inaccurate surface to be constructed or even prevent the ability to construct a surface at all.Among the range of spindle speed, feed, and depth of cut available possible in the machine the following three parameters are considered and make their combination for experiment. The modeling of input parameter has been give R_a and MRR

carried out using ANN techniques based on the experimental resultsas shown in table 2.

Table 2 Experimented data

Speed	Feed	Depth of cut	MRR	R_a
100	1	1.5	0.245	3.47
100	1.2	2	0.364	2.98
100	1.4	2.5	0.289	4.41
100	1.6	3	0.299	3.58
120	1	2	0.275	3.46
120	1.2	1.5	0.248	2.87
120	1.4	3	0.267	3.45
120	1.6	2.5	0.311	4.11
150	1	2.5	0.290	3.68
150	1.2	3	0.305	3.35
150	1.4	1.5	0.354	2.95
150	1.6	2	0.376	3.65
180	1	3	0.287	2.89
180	1.2	2.5	0.287	3.58
180	1.4	2	0.318	3.76
180	1.6	1.5	0.342	4.12

Several experimental design techniques have been used to aid in the selection of appropriate design points. Taguchi method is a powerful design of experiments tool for engineering optimization of a process. It is an important tool to identify the critical parameters and predict optimal setting of each parameter. Analysis of variance is used to study the effect of process parameters and establish correlation among the cutting speed, feed and depth of cut with respect to the major machinability factor.The output predicted data of milling process were obtain with error by applying ANN as shown in table 3.

Table 3 Simulation Result and Error

Simulation		Simulation Error	
MRR	R_a	MRR	R_a
0.2964	3.3134	0.06750	-0.4234
0.3096	3.3435	2.6703	1.0664
0.3227	3.3737	-0.0237	0.2062
0.2858	3.3991	-0.01081	0.06082
0.4696	3.0147	-0.2216	0.1447
0.4958	3.0750	-0.1848	1.0349

Regression Performance

Finally, a confirmation run is carried out to test the regression model is to predict new response. From the Regression plot of the generated model, shown in Fig.2, it can compare the effect of output factors of targets. The response of all target value is quit better as given below

- Training performance index are 90%
- Validation performance index are 88%
- Test performance index are 99%

All regression performance index are 91%

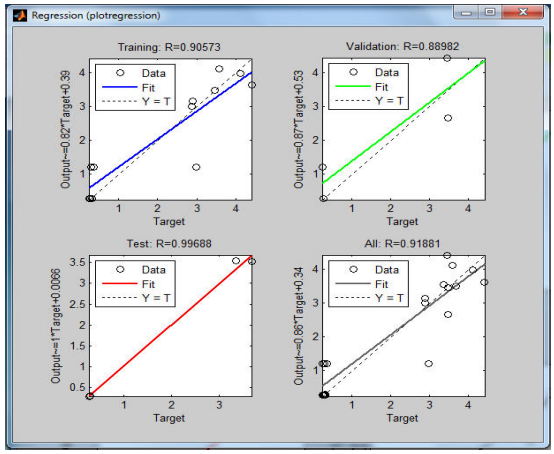

Fig 2 Regression Plots of Prediction

Conclusions

In case of test dataset it seems that NN tool box model is quite obvious from the results of the predictive models that the predicted accuracy was good and the predicted results matched well with the experimental values. The obtained data were used to develop the MRR and surface roughness models. The capability of the developed prediction models were evaluated by comparing its results with measured values.As the correlation between the machining and the surface roughness is strongly dependent on the material being machined, there is an impending need to develop a generic predictive platform to predict surface roughness. So the suitable compromise between selected cutting parameters and tolerance of results will have to be made.

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