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Original Research Article

OPTIMIZATION OF COOLING LUBRICANT ON MACHINING PROCESS PARAMETERS

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ABSTRACT

Industrial productivity, respecting the general rules of work and ecology of the environment system by avoiding several types of machining, research is directed towards the steels with improved machinability and coating cutting tools. Design of experiment obtained through Full Factorial design, a total of 27 tests were carried out and optimum level for MRR and cutting force were chosen from the three levels of cutting parameters considered. The experimental data's are later used to predict output data by using artificial neural network. Neural network algorithms are developed for use as a direct modeling method, to predict MRR only for machining parameters. Prediction of MRR is often needed in order to establish result forecasting of the machining processes. The neural network design and development was done using MATLAB.

KEYWORD: Cutting Force, MRR, Full Factorial, ANN.

1. INTRODUCTION

Metal cutting process forms the basis of the engineering industry and is involved either directly or indirectly in the manufacture of nearly every product of our modern civilization. The cutting tool is one of the important elements in realizing the full potential out of any metal cutting operation. Over the years the demands of economic competition have motivated a lot of research in the field of metal cutting leading to the evolution of new tool materials of remarkable performance and vast potential for an impressive increase in productivity. An area of research interest in metal cutting is the analysis of cutting force, as minimum power consumption is a never ending endeavor. Turning is a very important machining process in which a single point cutting tool removes unwanted material from the surface of a rotating cylindrical work piece. The cutting tool is fed linearly in a direction parallel to the axis of rotation. The cutting forces are used as the indicator of the tool flank wear variation. The basic idea is using MATLAB software or measured value attain the training sample that reflects the relationship between the structure and input (structure parameters) output (structural response), then respectively as the output-input of the neural network to train network, so as to realize the nonlinear inverse mapping from output parameters space to input parameter space. But this method can't get the right result in the spindle contains multiple design variables, therefore the usable range is very narrow. Chen et. al. [1] presents paper on predictions of cutting vibrations are necessary for improving the operational efficiency, product quality, and safety in the machining process, since the vibration is the main factor for resulting in machine faults. Bhagora & Shah [2] focused on the modelling of cutting conditions to get lowest surface roughness in turning ASTM A242 TYPE-2 ALLOYS STEEL by Artificial neural network and Regression Analysis method on the CNC lathe. Saikumar and Shunmugam[4] they have conducted a study on high speed machining with rough and finish end-milling.

2. OBJECTIVE OF PRESENT WORK

The most appropriate strategy available to the manufacturers and researchers to reduce the possibility of material consumption is to introduce some form of feedback representing the quality of machining during the process.

- The influence of cutting parameters (speed, feed, and depth of cut) on cutting forces and MRR has been analyzed. Under the different cutting conditions.
- 27 experiment based Full Factorial design was used to study cutting force (Fx, Fy and Fz) and Material removal Rate (MRR) of turning on hardened mild steel work-piece.
- Full Factorial function was adopted to optimize the turning process with multiple performance characteristics. The machining parameters setting of were found by using ANOVA for analysis of variance table for maximum cutting force and minimum MRR.
- Apply artificial neural networks on 70% data for training and rest 30% have to simulate for comparison and detect the error.

3. MATERIALS AND METHOD

The present work deals with the turning of hard material such as AISI 4340 steel. It is an important engineering material employed in manufacturing of components in auto and aerospace industries. Since the present trend in the manufacturing industry is high speed dry machining, it was applied to evaluate the performance of coated tools in typical manufacturing processes. The lathe tool dynamometer was used for measuring cutting force and material removal rate. These steels are used for cutting metals at a much higher cutting speed than ordinary carbon tool steels. The forces acting on a tool are an important aspect of machining for studying the machinability conditions. Knowledge of the cutting forces is needed to estimate the power requirements and ensure that the machine tool elements, tool-holders, and fixtures are adequately rigid and free from vibrations. The challenge of modern machining industries is mainly focused on the achievement of high quality, in terms of work piece dimensional accuracy, high surface finish, high production rate, Chip formation ,less tool wear on the cutting tools, economy of machining in terms of cost saving and increase the performance of the product with reduced environmental impact. 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. Among the various neural network models Back Propagation (BP) is the best general purpose model and probably the best at generalization. Back propagation method will make strong network from start data to the end data and construct a cyclic network with minimum error. The typical neural networks architecture is shown in the Figure 1.

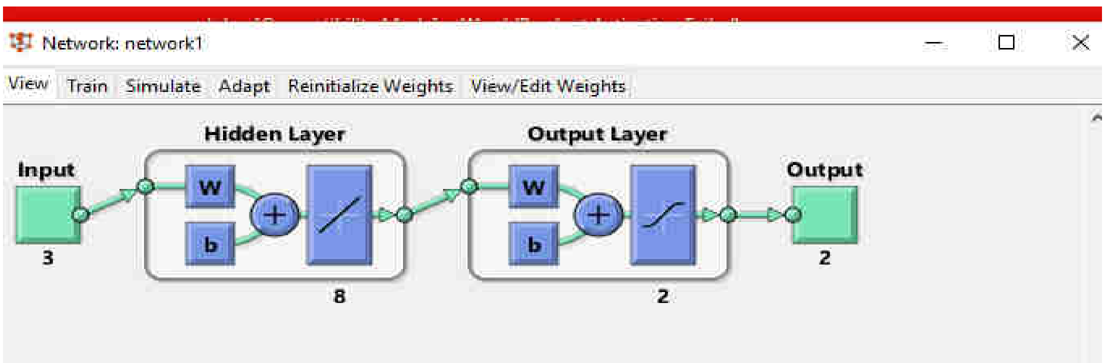

Fig. 1 Created Neural Network

4. RESULT ANALYSIS

The results also show that cutting forces and MRR are shown in fig 2 and Fig 3 respectively increase with increasing feed rate and depth of cut because chip thickness becomes significant what causes the growth of the volume of deformed metal. Minimal values of cutting forces were obtained at Vc = 310 rpm, f = 0.1 mm/rev and d = 0.1 mm (test number 13). That means increasing of cutting speed with lowest feed rate and depth of cut leads to decreasing of cutting force components. Maximal values of cutting force components (Fx, Fy and Fz) were registered at Vc= 120 m/min and f = 0.2 mm/rev and d= 0.3 mm (test number 23). In order to achieve better machining system stability, the highest level of cutting speed, 310 m/min, the lowest level of feed rate, 0.01 mm/rev, the lowest level of depth of cut, 0.1 mm, should be recommended.

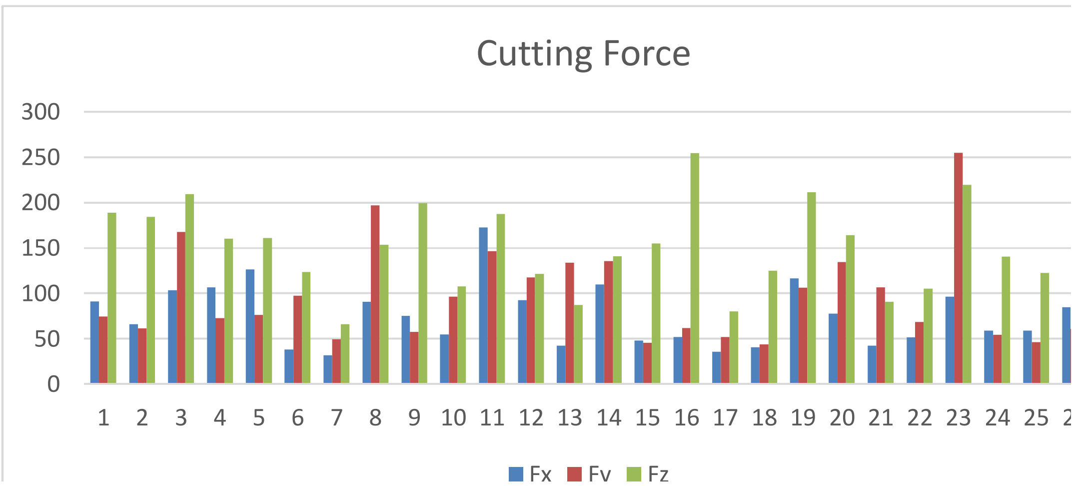

Figure 2 Cutting Force Obtained

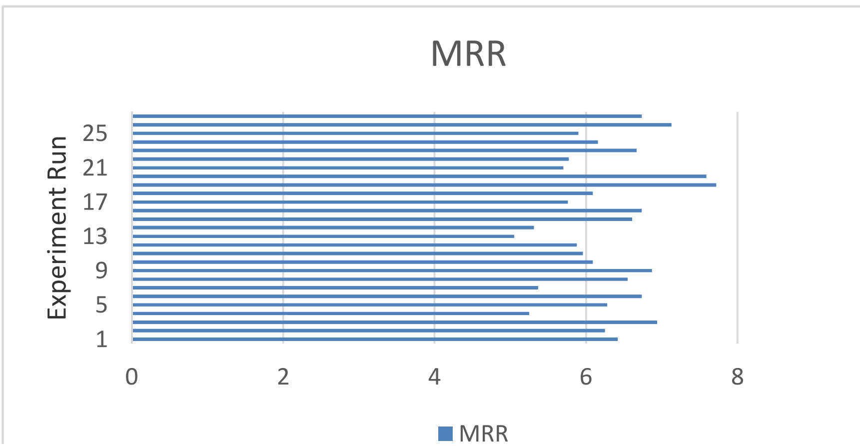

Fig 3 MRR Values

MRR Responses are to be forecast by ANN technique but first it would have to create the network and train the 22 experiment data to make forecast for next 5 experimented data, check the error by comparing the simulated and experimented responses. This simulation is done in MATLAB nntool as shown in Fig

4.

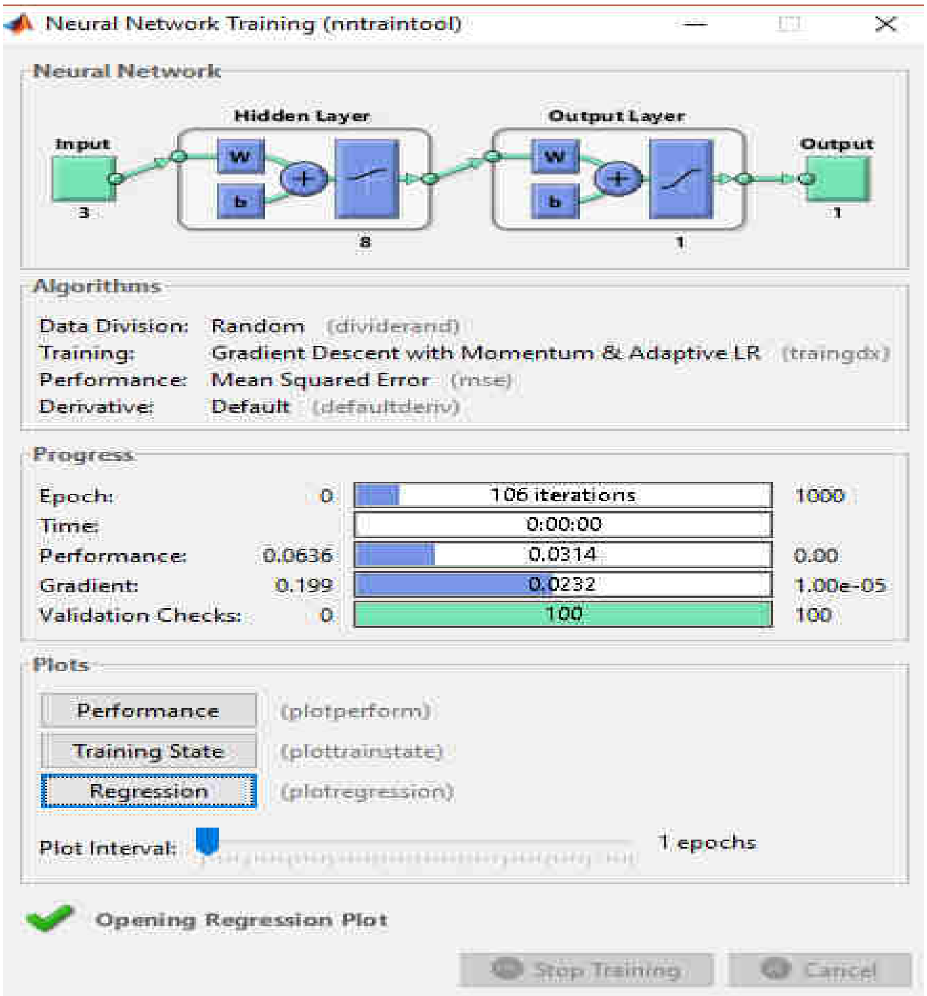

Fig 3 Simulation of ANN

The output variable, i.e. Material removal rate (MRR) is compared with experimented data and found the error in between them whose characteristics are given in Table 2. For this kind of main principle is to found the technique accuracy processed to the value of output quantity can be obtained.

Table 2 Comparison Table

Experimented	Simulated	Error
MRR	**MRR**	**MRR**
6.67	6.25	0.42
6.16	5.77	0.39
5.9	5.81	0.09
7.13	6.55	0.58
6.74	6.58	0.16

Where, calculated error is obtained by taking difference of experimented result and simulated result. In this table seen that close error is obtain for MRR is 0.09 and for MRR is 0.58.

5. CONCLUSIONS

Full Factorial Design method is found to be a successful technique to perform trend analysis of Cutting Force in metal cutting with respect to various combinations of design variables (metal cutting speed, feed rate, and depth of cut. Response model for Fz is more precise than first Response model for Fx and second Response model for Fy in predicting the power consumption and significant during machining. In case of test dataset it seems that NN tool box model is quite obvious from the results of the predictive models that predicted accuracy was good and the predicted results matched well with the experimental values. But on the other side this mean that neural network will became more complex and the calculating time will extend.

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