JOURNAL OF SCIENTIFIC RESEARCH IN ALLIED SCIENCES
ISSN NO. 2455-5800
Contents available at: www.jusres.com

APPLICATION OF ANN TECHNIQUE TO PREDICT TOOL WEAR WITH VARIATION OF TURNING OPERATION PARAMETERS

Giriraj Garhewal,[1] Vipin Katiyar[2], Shoaib Mohammed[3]
1. Ph.D. Scholar, Chhatrapati Shahu Ji Maharaj University, Kanpur
2. Professor, Chhatrapati Shahu Ji Maharaj University, Kanpur
3. M. Tech. Scholar, Chouksey Engineering College Bilaspur

ARTICLE INFO | ABSTRACT | ORIGINAL RESEARCH ARTICLE

Article History
Received: Sept' 2018
Accepted: Oct' 2018
Keywords:
ANN Technique, Turning operation, tool wear.

Corresponding author
Garhewal G.*

The quality of the machined piece and tool life are greatly influenced during the machining operation. For that reason, engineers waste a lot of time and efforts trying to reduce to the l wear according to the design drawing during the turning process. In this work, an artificial neural network (ANN) modeling is used to analyze tool wear an in cutting condition of carbide coated. Factors and responses parameters based an ANN technique has developed a model to predict the output. Multilayer perceptron artificial neural network or the tool wear monitoring in turning gives an optimized result. By observed ANN model provided decent satisfactory results, and that it can be used for online tool wear estimation.

1. INTRODUCTION

Tool wear has a large influence as responses of the machining operations. Prediction of tool wear is multifaceted because of the complexity of the machining system. Dimensional correctness, tool wear and quality of surface finish are three factors that manufacturers must be able to control at the machining operations to ensure better performance and service life of engineering component. Turning is an important machining process within which a single point cutting tool removes unwanted material from the surface of a rotating cylindrical workpiece. Manufacturing leading edge is facing the challenges of higher productivity, quality, and the overall economy in the field of manufacturing by machining. The cutting tool is one of the vital components in realizing the total potential out of any metal cutting operation. It has been found that product quality as the most important part of the manufacturing industry and it continues to improve, depend upon the competition and buyer strategies. Higher quality of recent trend is toward, lower cost and smaller batch sizes, it is necessary to find out new technology that can help us to improve the business field. To predict responses an artificial neural network (ANN) model for the analysis and prediction of the relationship between cutting and process parameters during turning of medium carbon steel by the uncoated SNMG insert. The factor inserted in the Artificial Neural Networks (ANN) model is the machining parameters: speed, feed, depth of cut and cutting time. Artificial

Neural Networks (ANNs) have been widely used for prediction ting complex the manufacturing process due to their learning and generalization capabilities, accommodation of non-linear variables, adaptivity to changing environments and resistance to missing data. Considering the type of the parameter of the cutting process that is monitored, wide range from tool wear is presented. Regarding the monitoring on tool wear, it describes artificial neural network (ANN) applied to classify the the the wear obtained.

2. REVIEW WORK

Ambedkar et al. present work is to review the paper on the performance of multilayer coated tool in machining of hardened steel (AISI 4340 steel) under high speed turning. The depth of cut influences tangential cutting force more than radial and axial forces.[2]. Astakhov analyzes geometrical characteristics of tool wear are subjective and insufficient. First, they do not account for the tool geometry (the flank angle, the rake angle, the cutting edge angle, etc.), so they are not suitable to compare wear parameters of cutting tools having different geometries. Second, they do not account for the cutting regime and thus do not reflect the real amount of the work material removed by the tool during the tool operating time, which is defined as the time needed to achieve the chosen tool life criterion. [4]. Chandrasekaran et al. Presented work on surface roughness prediction model in the cylindrical grinding of LM25/SiC/4p metal matrix composites (MMC) was developed using artificial neural network (ANN) methodology. The independent input machining parameters considered in the modeling were wheel velocity, feed, workpiece velocity and depth of cut. The neural network architecture 4-12-1 with logsig transfer function was found optimum with 94.20 % model accuracy. Das et al present work on optimization of surface roughness in hard turning of AISI 4340 Steel using coated carbide inserts. The workpiece used in this paper is AISI 4340 and the tool material is multilayer coated carbide insert (TiN/TiCN/Al2O3/ZrCN) CNMG 120408 insert. The feed was found to be the most significant parameter for the workpiece surface roughness (Ra) with a percent contribution of 52.55%.[5]. Glendale et al. worked concerned an experimental study of turning on chromium – molybdenum case hardening alloy steel of AISI 4140grade. This work is studied on the effect of speed, feed, and depth of cut on material removal rate, metal surface and tool wear in machining AISI 4140 alloy steel using tungsten carbide tipped cutting tool. After taking the responses grey relation analysis apply to all experiment to optimize the input parameter for optimum response.[7]. Hossam et al. present a real-time simulation used to design and implement an artificial neural network. Artificial neural networks (ANN's) are an approach to evolve an efficient model for estimation of surface roughness, based on a set of input cutting conditions [8]. Lahiff et al. investigate on tool wear have a large influence on the economics of the machining operations. Prediction of tool wear is complex because of the complexity of the machining system. Tool wear in cutting process is produced by the contact and relative sliding between the cutting tool and the workpiece and between the cutting tool and the chip under the extreme conditions of cutting area; the temperature at the cutting edge can exceed 1000 °C. Thus, knowledge of tool wear mechanisms and capability of predicting tool life are important and necessary in metal cutting.[9] Khorasani et al. proposed CNC milling process, proper setting of the cutting parameter are important to obtain better surface roughness. The purpose of this research is to develop a mathematical model using multiple regression and ANN model for the artificial intelligent method.

3. METHODS AND MATERIAL

The experiments were carried out on a conventional CNC lathe. A CSRPR 2525 tool holder was used fitted with a SNUN 120408 carbide insert coated HSS tool. Characteristic of the applied grade P-20 alloy steel is taken as a job for cutting. The experimental system was developed with the objective to obtain optimize of the tool wear, which then can be used to test and analyze. A general study of flank wear for lathe tools and work-piece materials or different processing parameters is beyond the scope of in this study. The mechanism behind the formation of tool wear in CNC Lathe turning process is very dynamic, complicated, and process dependent. In a back-propagation neural network, the learning algorithm has two phases. Initially, the training input pattern is presented to the network input layer. The network for input pattern from layer to layer until the output pattern is generated by the output layer. Different from the desired output an error is calculated and then propagated backward through the network from the output layer to the input layer. The weights are defined as the error is propagated. Neural network with a back-propagation one is determined by the connections between the neuron (the network's architecture), the activation function used by the neurons, and the erudition algorithm (or the learning law) that specifies the procedures for adjusting weights.

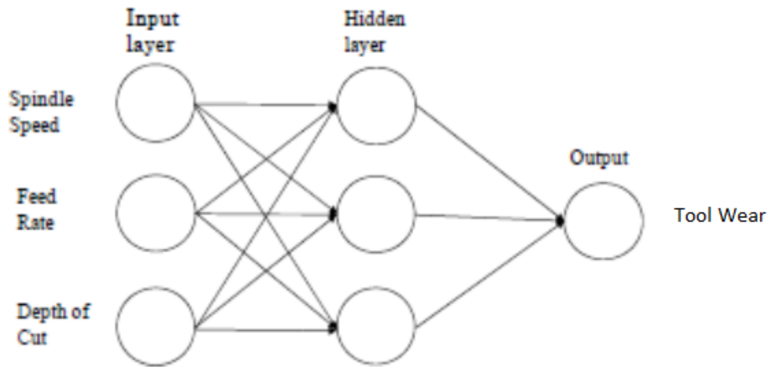

Fig 1. ANN Computational Model

4. EXPERIMENTAL DETAILS

The experiments have been conducted using industrial CNC lathe in dry conditions. The workpiece material is heat treated P-20 alloy steel. The dimensions of the cylinder-shaped bar used for experimentation are 80 mm diameter and 200 mm length. Prior to the machining tests, the work material was cantered and cleaned by getting rid of the layer of rust from the outside surface. Operation of machining are performed as per L9 orthogonal array design parameters then the tool wear is measured. The levels of process parameters considered are given in Table 1.

Table 1 Process Parameters and Levels

	Speed RPM (S)	**Feed mm/min (f)**	**Depth of cut mm (d)**
Level 2	1500	250	0.4
Level 3	2000	300	0.5

Level 4	2500	350	0.6

To measure tool wear, the insert is detached from the tool holder after machining. The optical microscope is used for measuring the tool wear. The tool wear acquisition for each cutting condition is shown in Fig. 5.

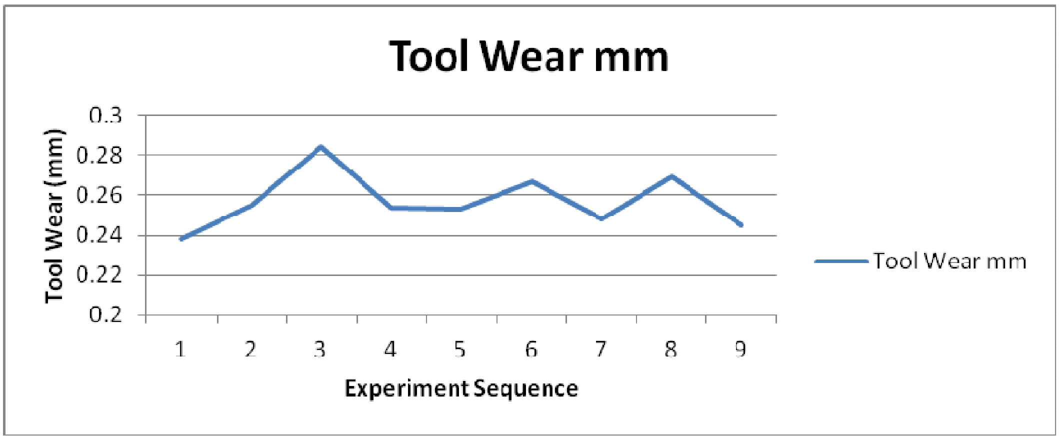

Fig 2 Responses of Experiment

Responses are to be forecast by ANN technique but first, it would have to create the network and train the 06 experiment data to make a forecast for next 3 experimented data, check the error by comparing the simulated and experimented responses. This simulation is done in MATLAB tool as shown in Fig 3.

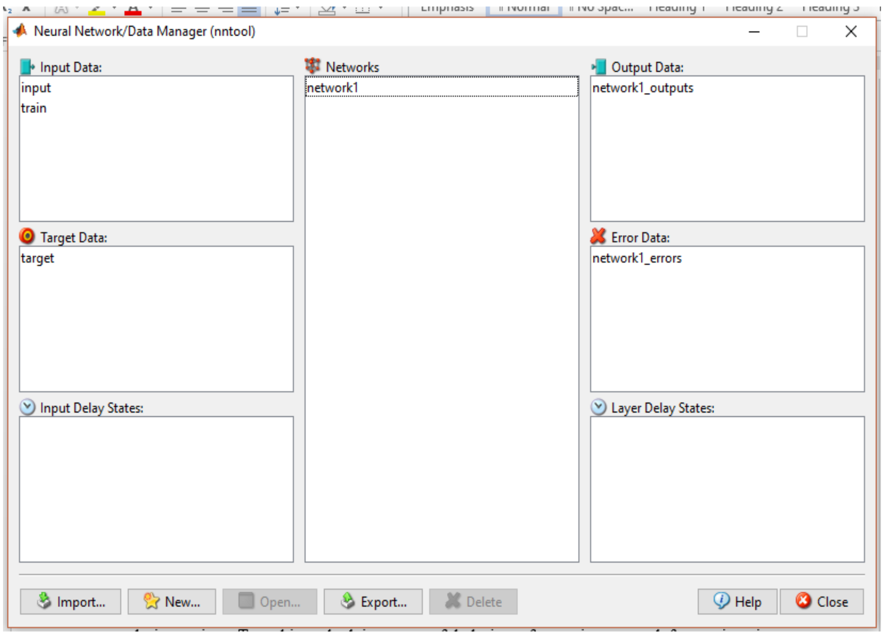

Fig 3. NN tool to create a network

Regression Performance

Regression model confirm run is carried out to test to predict new response. From the Regression plot of the generated model, shown in Fig.4, it can compare the effect of output factors of targets. The target value is quite better for all response as given below.

- Training performance index is 99%
- Validation performance index is 99%

- Test performance index is 99%
- All regression performance index is 99.

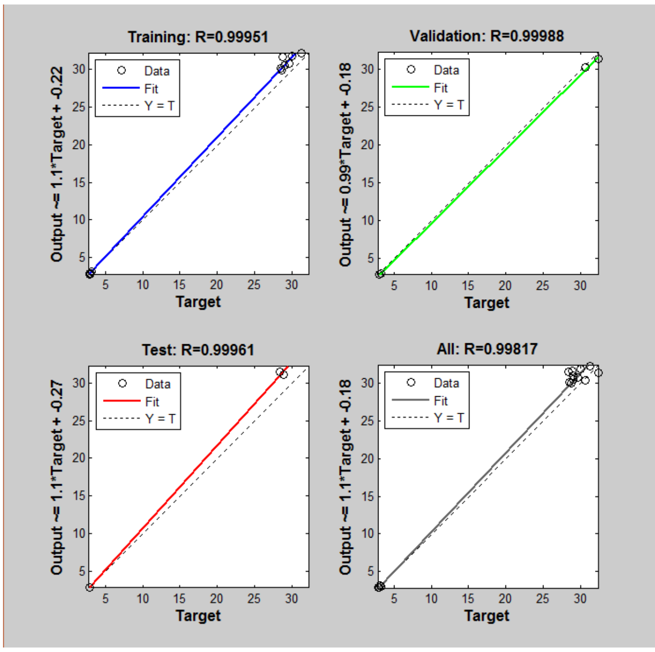

Fig 4 Regression Analysis

Regression performance is better so it gives a good result after this regression validation simulates the network against simulate data or to forecast data for the next 3 experiment. The output variable, i.e. tool wear is compared with experimented data and found the error in between them whose characteristics are given in Fig 5. For this kind of the main principle is to found the technique accuracy processed to the value of output quantity can be obtained.

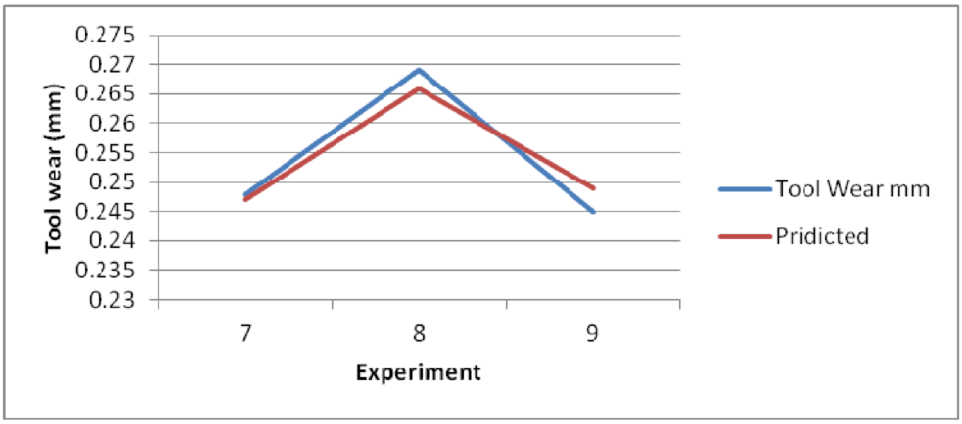

Fig 5. Comparison Graph of actual and predicted Tool wear

5. DISCUSSION

The cutting tools fail by wear occur due to plastic deformation and are very harmful to both machine and workpiece. So it should be totally eliminated by using favorable condition and taking a high factor of safety. The learning process or knowledge acquisition takes place by presenting to neural networks NN width a set of training examples and NN1 through learning algorithm. It is very difficult to know which training algorithm will be the fastest for a given problem. It depends on many factors, including the complexity of the problem, the number of data points in the training set, the number of weights and biases in the network, the error goal and whether the network is being used for pattern recognition or function approximation. The network is characterized by their topology, weight vectors and activation function that are used in hidden and output layers of the network. Linear output, Networks with biases, a sigmoid layer are capable of approximating any function with a finite number of discontinuities. As seen in the comparison graph all values of predicted are quite close to actual tool wear.

6. CONCLUSION

It is found that the orthogonal array parameter design of experiment method provides a simple, systematic and efficient methodology for the optimization of process parameters. The machining parameters were used as inputs to the ANN to design the network for the forecast of responses. Design of experiment is reducing the experiment and is done by lathe machine. In the case of the test dataset, it seems that the ANN 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.

7. REFERENCES

[1]. Ambilkar P, Kumari T P, Shrivas S P, (2017), Optimization Of Turning Parameter For AISI 4140 By Grey Relation Analysis, Jour. Sci. Res. A. Sci. 3(2), 141-147.

[2]. Astakhov V P, (2004), The assessment of cutting tool wear. Int J Mach Tools Manuf., 44(6), 637–47.

[3]. Chandrasekaran M, Devarasiddappa, D, (2014), Artificial neural network modeling for surface roughness prediction in the cylindrical grinding of Al-SiCp metal matrix composites and ANOVA analysis, Advances in Production Engineering &Management, 9(2), 59–70, ISSN 1854-6250.

[4]. Gendele S K, Shrivas A, Kachhawa A, (2018), Review On Prediction Parameters Of Turning Operation On Hardened Steel, Jour. Sci. Res. Allied Sci., 1 (4), 12-24.

[5]. Hossam M. Abd El-rahman, R. M. El-Zahry, and Y. B. Mahdy, (2013), Implementation of a neural network for monitoring and prediction of surface roughness in a virtual end milling process of a CNC vertical milling machine, Journal of Engineering and Technology Research, 5(4), 63-78, ISSN 2006-9790.

[6]. Lahiff C, Gordon S, Phelan P, (2007), PCBN tool wear modes and mechanisms in finish hard turning. Robot Cim-int Manuf, 23(6), 638–44.

[7]. Khorasani A M, Yazdi M R S, Safizadeh M S, (2011), Tool Life Prediction in Face Milling Machining of 7075 Al by Using Artificial Neural Networks (ANN) and Taguchi Design of Experiment (DOE), IACSIT International Journal of Engineering and Technology, 3(1), 30-35, ISSN: 1793-8236.

[8]. Sonani T D, Kushwaha D Y, Acharya G D, (2016), Review Of Tool Wear Estimation Using Response Surface Methodology, International Journal of Advanced Engineering and Research Development, 3(1), 147-150.

[9]. Yuefeng Y, Wuyi C, Liansheng G, (2010), Tool Materials-Rapid Selection Based on Initial Wear, CIRP -Journal of the International Academy for Production Engineering, 23(1), 386-392.