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Tool wear monitoring and process in milling of titanium grade5

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Abstract: Tool wear is a major loss of finance for the industry and a major area of research. With time various studies have been conducted for its research and monitoring so that tool wear can be monitored, predicted and hence controlled. If this is done it would account for saving huge losses incurred to the industry not just in terms of finance but also in terms of time of production and loss of material. This paper discusses the review of tool wear mechanisms, sensors used for monitoring tool wear and optimization techniques.

Key words: Optimization, regression, ANN, BPANN.

INTRODUCTION

In an era of intensive competition, the main motive of all industries is fastest production in minimum cost. Many techniques like just in time, ABC analysis and more are being regularly studied, modified and incorporated for the same. At the core of this lies the monitoring of tool since without these the production activities would come to get hindered. This review here is regarding the various activities concerned for tool wear monitoring. These include knowing the various mechanisms by which tool wear may occur and the one which incurs the maximum loss. It also overviews the various techniques of optimization and the various sensors and their advantages and disadvantages.

LITERATURE SURVEY

Different papers published on science direct and certain journals involving the various experiments pertaining Titanium grade 5 have been reviewed below. From these papers it is become easier to limit the parameters on Titanium grade 5 and further study them. The papers have brought forward the various properties of Titanium grade 5 under varying conditions. It has shown that application of tool wear monitoring is a pioneering concept and needs extensive research and comprehension. However, its study would very well increase reduction in machine downtime and raise productivity

For tool wear mechanism

Aspinwal [1] used flank wear to study tool wear mechanism in his work. Increasing the amount of cutting speed reduces the amount of residual compressive forces. Nurul-Amin et al [2] investigated the type of tool wear mechanism in milling of TiAL material with uncoated carbide and PCD tools. For both uncoated carbide and PCD tools,Increasing the cutting speed from 40 to 160 and from 120 to 250, respectively, increased surface roughness. Guo [3]investigated in the process of End milling using the parameters Speed, feed, depth of cut. The increase in surface roughness. Surface of the material became rougher when the depth of cutincreased due to increased overlap between cutting paths. Darwish [4] studied in the turning process with parameter speed, feed and depth of cut. The tool material of ceramics and CBN. The study was regarding increasing surface roughness. As depth of cut increased, surface quality decreased. Joshi et al [5] investigation Doesn't reveal a definite trend of surface roughness but it showed that as feed rate increases Surface Roughness decreases. Krishnamurthy [6] investigated the type of tool wear mechanism on work material Ti-4.5 Al-4.5mn with the help of tool material PCBN in turning process by taking parameters speed, feed and depth of cut. Surface roughness increases when cutting speed is increased. Aspinwall [7] investigated the tool wear mechanism on work material gyama-TiAl using tool material uncoated carbide in milling process under consideration of speed, feed and depth of cut. Decrease in cutting speed decreases the amount of compressive residual stress. Sridhar et al [8] worked with Ti-IMI-834 work material using coated carbide (TiN) in milling proess by taking speed. feed and depth of cut(DOC) into consideration. When the cutting speed was increased, the peak residual stresses decreased at low feed and depth of cut but increased at high feed and DOC. Nouari [9] investigated the type of tool wear mechanism on work material Ti-62425 using uncoated and coated carbide(TiN,TiC,TiCN)in milling process by considering speed, feed and depth of cut.

Michialidis [10] Fig. 1 summarizes the results of the width of flank wear VB versus the number of cuts at 50, 75, 100 and 125 m/min in dry down milling and a chip length lcu = 6 mm. It is worth noting that the uncoated tool could not practically

operate at higher cutting speeds due to severe sticking of the chip on the rake
and abrupt premature failure.

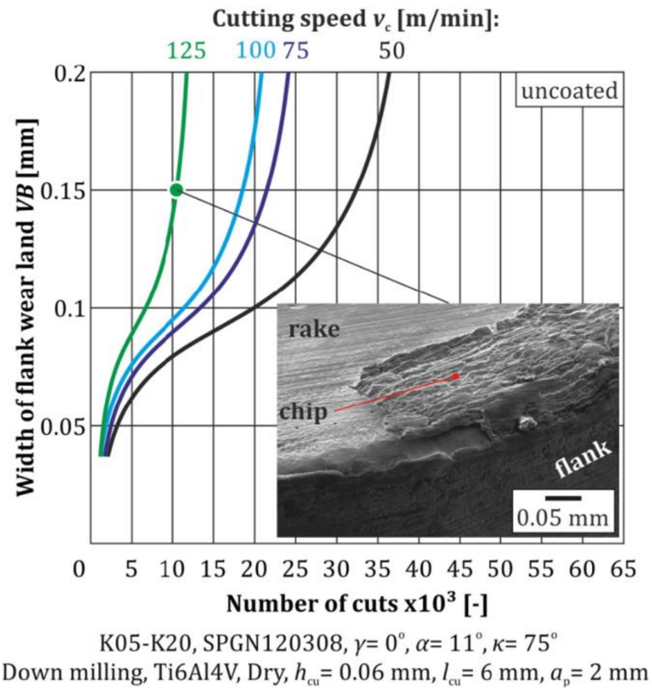

Fig. 1 Width of flank wear land VB versus the number of cuts developed in the uncoated tools at various cutting speeds.

For optimisation techniques

Romero [11] modeled the sound slope quantity of urban waterfronts by ANN. It was found that ANN performed better than linear regression equation. The results obtained show that the performance of the Neural network is better than the one of the linear regression (rANN = 0.949, rMLR = 0.639). Pentos [12] examined the contribution of variables in ANN models comparing the inherent instability. The results of the relative importance of variables are calculated as the average value for the group of ANN models by two or more methods for quantifying variable importance. This approach promises to produce relatively precise and reliable results and is valuable in real-world applications. Fang lu [13] determined the performances of the BPANN models by modeling chlorophyll-a concentartions by using ANN. 21 years of monitoring data (1992–2012) of water quality parameters was used to train, validate and test the BPANN models. The optimal input parameters of the model were selected on the basis of the performance of models built with different combinations of input variables.

The performances of the BPANN models were examined against observed chlorophyll-a concentration. Guallar [14] incorporated ANNs to successfully model the complex non linear dynamics of phytoplankton. This approach was applied to predict absence-presence and abundance of Karlodinium and Pseudo-nitzschia microalgae in Alfacs Bay (NW Mediterranean) using biological and/or environmental variables. Tahir [15] found the optimal scheduling of electrical power in energy deficient scenarios using ANN And Bootstrap aggregating. The results reveal the superiority of the Bootstrap aggregating algorithm over a conventional ANN technique using feed forward back propagation model. Báguena [16] Maria-Jose Corbaton Baguena determined the comparison between ANN and Hermia's models. The ANNs achieved results very accurate with good fitting to Experimental data. ANN is better than the Hermia's models. Uday Maji et al[17] This paper present a novel method for feature optimization and classification of electro cardiogram(ECG) for aeehythmia analysis Proposed work deals with ranking and selection an optimised of feature using taguchi method from eleven possible features Modification in the conventional taguchi method enable it to be used in the systems where the expected output is not specified. Ben Arfa et al [18] Taguchi planning was used for systematic study of the combine effects of five different parameter PH, synthesis temperature, synthesis time, during temperature and calcination tempareture in the precipitation synthesis of single-phase pure hydroxyapatite. Taguchi method is a powerful means to minimise the number of experiments required to achieve a fuller understanding of the effects of processing factors an HAP powder synthesised in aqueous media.

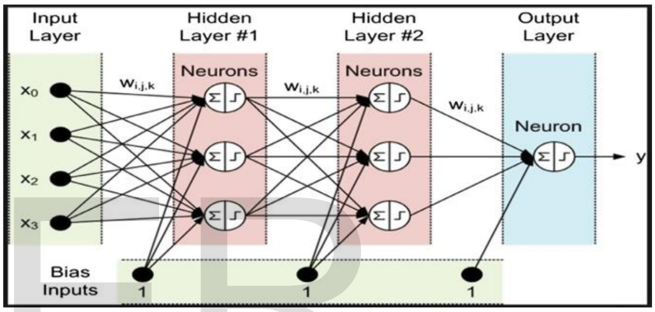

Fig.2 Structure of an ANN.

Tahir [15] in his paper for optimal scheduling of electrical power used the structure of ANN as shown in above fig.2

For variety of sensors

Prateepasen [19] utilized acoustic emission source as calibration source for tool wear monitoring in single point machining. Compared to the pulsed laser Air jet is more suitable as an artificial calibration source for measuring system for machining study and tool wear monitoring. Cook [20] inspected research focuses on monitoring methods involving expensive and complex sensor system placed in close proximity to the machining operation itself. Valerie G.Cook visually inspected the tool flank surface using a measuring microscope. Bhuiyam [21] et al found by using Acoustic emission and vibration signal the feed directional vibration component. The Acoustic emission sensor assesses the internal change where as the vibrating sensor demonstrates the external effect on tool state. malekian [22] got a result that monitoring of micro-milling operations is article to avoid excessive tool wear and to maintain part tolerances and surface quality. The effectiveness of tool wear monitoring based on a number of different sensor. Is also investigated several cutting tests are perform to verify the monitoring scheme for the miniature micro-end millings. Khorasani et al [23] did a study to discover the role of parameters in tool life prediction in milling operation by using ANNs and Taguchi design of experiment. It is sure to conclude that all the significant factor were included in the (DOE) process the research in the present paper can be extended toward three different step : (1) Taguchi (2) Modeling tool life by using ANN (3) Validation by carrying out the experimental tests.

Duspara et al [24] describes a fast Fourier transformation and its application to monitoring tool wear. It describes the transformation of the collected signal during cutting from the time domain to the frequency.It can be concluded that with the increase of tool wear, amplitude of frequency signal has a significant increase, frequency peak also increases in higher frequency zone, but not so much. Ning et [25] all found that Surface modification of titanium hydride with epoxy resin was carried out via microwave-assisted ball milling and the products were characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM), thermo-gravimetry (TG) and Fourier transform infrared spectroscopy (FT-IR). The surface modification of titanium hydride with epoxy resin was successfully achieved by applying microwave-assisted ball milling. The grafting site is located around the epoxy group as the epoxy ring was opened. Dong Yang and Zh Liu [26] This paper presents the effect of cutting parameters (cutting speed, feed rate and radial depth of cut) on surface topography in peripheral milling of titanium alloy Ti–6Al–4V. Peripheral milling experiments based on the Taguchi method have been conducted on Ti–6Al–4V to characterize surface topographies by various milling conditions. Compared to the values of surface roughness in the feed direction, the values are small and stable in the direction perpendicular to feed.

Bhuiyan [27] gave the following experimental setup for capturing acoustic emission signals in his paper to investigate the frequency of tool wear and plastic deformation in tool condition monitoring.

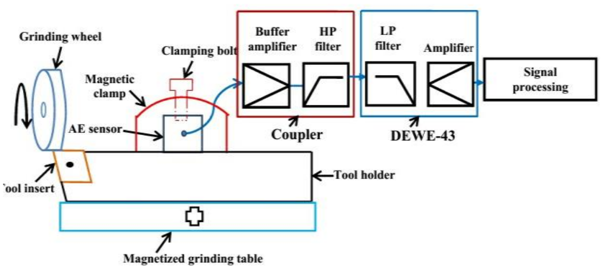

Fig.3 experimental setup to capture acoustic emission signals from the grinding test.

CONCLUSION

A number of conclusions were drawn from the literature survey done. Some of the important ones are listed as follows:

i. Surface roughness depends on :
   a) Depth of cut (increas epth es as dof cut increases).
   b) Feed rate (increases as feed rate increases.

ii. With the change in cutting speed:
   a) The peak residual stress decreased as cutting speed increased.
   b) The compressive residual stress decreased with decrease in cutting speed.

iii. The performance of neural networks is better than linear regression.

iv. ANNs are better than Hermia's models.

v. The acoustic emission sensor assesses the internal change whereas the vibrating sensor demonstrates the external effect on tool state.

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