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Performance Analysis of Surface Roughness modeling using Soft Computing Approaches

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Abstract: In this paper, classification algorithms are used to classify the test data samples for determining the error rate by comparing its classification response with actual response. In this paper, Random Forest (RF) and Adaptive Neuro Fuzzy Inference System (ANFIS) classification algorithms are used as soft computing techniques to determine the error rate for the prediction of surface roughness of the materials. The parameters feed, depth of cut, speed and mean are extracted from the test sample materials and they are given to classification mode of the ANFIS classifier which produces vision measurement value. The error rate is determined by subtracting the vision measurement values from the stylus instrument values. The performance is compared with other conventional methods.

Keywords: classification, soft computing, stylus instrument, error rate, random forest

1 Introduction

The measurement of stylus instruments plays an important role in measuring or predicting the surface roughness of the materials. This is complex methodology and has less flexibility for various numbers of parts in material surface. This methodology is entirely based on post processing technique and it is not suitable for automobile equipment materials [1]. Nowadays, prediction of surface roughness of the work piece materials is done by computer aided approaches, which reduces the complexity of the process and work time. The quality and accuracy of the surface roughness prediction are often affected by poor surface image quality and cutting parameters. In this way, obtaining good quality of surface image of the materials is required for predicting the surface roughness through computer-aided approaches. The probabilistic neural networks were proposed in [1] to predict the surface roughness with respect to different cutting operations on various test materials. The methodology proposed in this work was not supported by low resolution surface-captured digital images. The authors achieved 6.2% of error rate by implementing this proposed method. In order to improve the efficiency of the surface roughness prediction, the accurate measurement of cutting parameters as cutting speed, feed rate and depth of cutting of the work piece material. These cutting-edge parameters affect the functional behavior of the surface roughness prediction process [2].

A conventional classification methodology such as neural network [3] which adopts the concepts of fuzzy logic was developed in order to reduce the error rate of the surface prediction process. These conventional methods were suitable for only linear mapping operations and they are not suitable for non-linear operations [16].

Fig.1 shows the high resolution surface-captured image and Fig.2 shows the Low resolution surface captured image.

Maohua Xiao et al. [5] developed a methodology for predicting the surface roughness using response surface estimation method. In this method, the cutting speed, cutting rate with cutting depth was given as trained parameters for predicting the surface roughness. The regression model is used in this paper in order to improve the accuracy of the surface roughness prediction. Sarnobat et al. [7] designed a methodology for predicting the surface roughness through cutting tool vibration. The

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