ADVANCED MACHINING TOWARDS IMPROVED MACHINABILITY OF DIFFICULT-TO-CUT MATERIALS

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Chapter 19

Artificial Neural Network Algorithm for Predicting the Surface Roughness in End Milling of Inconel 718 Alloy

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1.0 INTRODUCTION

Surface roughness is one of the important factors for evaluating workpiece quality during the machining process because the quality of surface roughness affects the functional characteristics of the workpiece such as compatibility, fatigue resistance and surface friction. The factors that affect the surface roughness during the end milling process include tool geometry, feed rate, depth of cut and cutting speed. Several researchers have studied the end milling process in the recent years. The researchers also used response surface methodology (RSM) to explore the effect of cutting parameters as cutting speed, feed rate and axial depth of cut. Alauddin et al. [1] developed a mathematical model to predict the surface roughness of steel after end milling. The prediction model was expressed via cutting speed, feed rate and depth of cut. Fuh and Hwang [2] used RSM to construct a model that can predict the milling force in end milling operations. But as the machining process is nonlinear and time-dependent, it is difficult for the traditional identification methods to provide an accurate model. Compared to traditional computing methods, the artificial neural networks (ANNs) are robust and global. ANNs have the characteristics of universal approximation, parallel distributed processing, hardware implementation, learning and adaptation, and multivariable systems [3]. ANNs have been extensively applied in modeling many metal-cutting operations such as turning, milling, and drilling [4-5]. However, this study was inspired by the very limited work on the application of ANNs in modeling the relationship between cutting conditions and the surface roughness during high-speed end milling of nickel-based, Inconel 718 alloy.

2.0 ARTIFICIAL NEURAL NETWORK DESIGN

Supervised neural network was developed in this study for the prediction of surface roughness in end milling process and its performance was tested. The network was back propagation neural network (BP) with log-sigmoid transfer function in hidden layers and linear transfer functions in the output layers. The neural network architecture used in this study is shown in Figure1. It was designed using MATLAB Neural Network Toolbox [6].