Chapter 9
A Novel Machine Learning-Based Optimizing Multipass Milling Parameters for Enhanced Manufacturing Efficiency

Aditi Sharma
Institute of Engineering and Technology, Lucknow, India

Hari Banda
http://orcid.org/0000-0003-4629-2830
Villa College, Maldives

N. Dhamodharan
Dr. Mahalingam College of Engineering and Technology, Pollachi, India

J. Ramya
St. Joseph's College of Engineering, Chennai, India

Priya Shirley Muller
Sathyabama Institute of Science and Technology, Chennai, India

M. D. Rajkamal
Velammal Institute of Technology, Chennai, India

ABSTRACT

The present research studies the optimization of multipass milling parameters for AISI 304 stainless steel, adopting a systematic experimental technique based on the Taguchi L9 array design. The research methodically adjusts cutting speed, feed rate, and depth of cut, documenting their impacts on surface roughness. Experimental data, obtained with a Mitutoyo portable surface tester, are the foundation for

DOI: 10.4018/979-8-3693-3314-3.ch009

training machine learning models. The linear regression (LR) model, trained using 1200 measurements, produces a prediction equation with a remarkable accuracy of 92.335%, offering insights into the linear correlations between machining parameters and surface roughness. Concurrently, an artificial neural network (ANN) model, exhibiting 100% accuracy, captures non-linear patterns inherent in the milling process. The actual vs. anticipated values table for the LR model further demonstrate its predictive powers.

INTRODUCTION

Stainless steel, especially AISI 304, is a commonly utilised material in numerous sectors owing to its corrosion resistance, strength, and aesthetic appeal (Sendrayaperumal et al., 2021). However, machining AISI 304 stainless steel offers issues owing to its work-hardening rate, limited heat conductivity, and susceptibility for tool wear (Ramesh et al., 2022). To improve the milling process and obtain maximum machining performance, experts have studied numerous optimization strategies (Sathish et al., 2022; Sureshkumar et al., 2022). The merging of Taguchi design and machine learning approaches has attracted attention in the optimization of AISI 304 stainless steel milling (Hemalatha et al., 2020; Venkatesh et al., 2022). Taguchi design, a statistical design of experiments (DOE) technique, allows for the systematic study of the machining parameters and their relationships (Nadh et al., 2021). It aids in discovering the ideal parameter settings that lead to enhanced machining performance. By employing Taguchi design, researchers may decrease the number of tests necessary and quickly examine the impact of numerous parameters on the milling process (Kanimozhi et al., 2022). Machine learning methods have also been added into the optimization process to further boost the accuracy and efficiency of the optimization. Machine learning methods, such as artificial neural networks (ANNs), support vector machines (SVMs), and decision trees, can examine vast datasets and capture complicated correlations between input parameters and output responses (Karthick et al., 2022; Muthiya, Natrayan, Yuvaraj, et al., 2022; Vaishali et al., 2021). These models may learn from the data and give insights into the ideal parameter settings for obtaining desired machining outputs (Palaniyappan et al., 2022).

The merging of Taguchi design with machine learning provides various benefits. It enables for a full investigation of the parameter space, including both major effects and interactions (Sathish et al., 2021). Machine learning models can manage nonlinear connections and capture complicated patterns, which is advantageous for improving the milling process of AISI 304 stainless steel (Natrayan & Kumar, 2020). By combining the characteristics of Taguchi design with machine learning, researchers may generate more precise and trustworthy optimization outcomes (Muthiya, Natrayan,

Related Content

The Position of Rough Set in Soft Set: A Topological Approach

Tutut Herawan (2012). *International Journal of Applied Metaheuristic Computing (pp. 33-48).*

www.irma-international.org/article/position-rough-set-soft-set/70237