Review of: "Optimized Material Removal and Tool Wear Rates in Milling API 5ST TS-90 Alloy: AI-Driven Optimization and Modelling with ANN, ANFIS, and RSM"

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Potential competing interests: No potential competing interests to declare.

Title: Optimized Material Removal and Tool Wear Rates in Milling API 5ST TS-90 Alloy: AI-Driven Optimization and Modeling with ANN, ANFIS, and RSM

Abstract:

The manuscript discusses the optimization of Material Removal Rate (MRR) and Tool Wear Rate (TWR) in milling API 5ST TS-90 alloy using Response Surface Methodology (RSM) and artificial intelligence-based models. The study involves the application of artificial neural networks (ANNs) and adaptive neuro-fuzzy inference systems (ANFIS) to model and optimize these crucial manufacturing parameters. The research is based on twenty experimental runs using a ZX6350C milling machine and a 10 mm HSS end-mill cutter, designed through Central Composite Design (CCD) in Design Expert 14 software. The predictive capabilities of RSM, ANN, and ANFIS yielded a coefficient of determination above 0.85.

Main Findings:

The study's findings indicate that both ANFIS and RSM marginally outperformed ANN in predicting MRR, while ANFIS and RSM were slightly better than ANN in predicting TWR. Notably, ANFIS exhibited superior predictive capabilities for both MRR and TWR. The optimum milling parameters for achieving an optimized MRR of 1272.163 mm3/min and TWR of 0.781 mm/min were identified as a 720-rpm spindle speed, 24 mm/min feed rate, and a 0.979 mm depth of cut.

Validation:

To validate the obtained results, milling experiments were conducted under the suggested optimum conditions. The results demonstrated a close correlation between the predicted and validated values, with an MRR of 1270.05 mm3/min and a TWR of 0.77 mm/min. These findings support the effectiveness of the proposed optimization parameters and their potential for enhancing production while reducing tooling costs associated with tool wear.

Keywords:

Artificial Neural Network, Adaptive Neuro-Fuzzy Inference System, End Milling, Material Removal Rate, Response Surface Methodology, Tool Wear Rate

Conclusion:

In conclusion, this study successfully employed RSM, ANN, and ANFIS models to predict and model the milling process with a coefficient of determination exceeding 0.85. Comparatively, ANFIS demonstrated slightly better predictive capabilities for MRR and TWR than ANN and RSM, with RSM also surpassing ANN's predictive performance. The identified optimal milling parameters promise improved MRR and reduced TWR: a 720 rpm spindle speed, 24 mm/min feed rate, and a 0.979 mm depth of cut. The validation experiments confirmed the accuracy of these parameters in practice.

This study's outcomes have the potential to significantly enhance production processes for machinists and production engineers, ultimately leading to cost reductions associated with tool wear. The research is commendable for its rigorous methodology and insightful contributions to the field of manufacturing optimization.