Documents

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Computational analysis and artificial neural network optimization of dry turning parameters-AA2024-T351

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Abstract

In dry turning operation, various parameters influence the cutting force and contribute in machining precision. Generally, the numerical cutting models are adopted to establish the optimum cutting parameters and results are substantiated with the experimental findings. In this paper, the optimal turning parameters of AA2024-T351 alloy are determined through Abaqus/Explicit numerical cutting simulations by employing the Johnson-Cook thermo-viscoplastic-damage material model. Turning simulations were verified with published experimental data. Considering the constrained and nonlinear optimization problem, the artificial neural networks (ANN) were executed for training, testing, and performance evaluation of the numerical simulations data. Two feedforward backpropagation neural networks were developed with ten hidden neutrons in each hidden layer. The Log-Sigmoid transfer function and the Levenberg-Marquardt algorithm were applied in the model. The ANN models were studied with four input parameters: the cutting speed (200, 400, and 800 m/min), tool rake angle (5°, 10°, 14.8°, and 17.5°), cutting feed (0.3 and 0.4 mm), and the contact friction coefficients (0.1 and 0.15).The two target parameters include the tool-chip interface temperature and the cutting reaction force. The performance of the trained data was evaluated using root-mean-square error and correlation coefficients. The ANN predicted values were compared both with the Abaqus simulations and the published experimental findings. All of the results are found in good approximation to each other. The performance of the ANN models demonstrated the fidelity of solving and predicting the optimum process parameters. © 2017 by the author.

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