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NEURAL NETWORK BASED MODELS FOR SURFACE ROUGHNESS OBTAINED DURING ELECTROCHEMICAL MACHINING OF SG IRON.

BISHNU M JHA[1] & A. MANDAL[2]

[1]Centre for Energy Engineering, Central University of Jharkhand, Ranchi, India

[2]*Department* of Manufacturing, Engineering, NIFFT, Hatia, Ranchi, India

ABSTRACT

Only a few parameters that affect the machining process in ECM are controllable. It is clearly established from reported works that results reported in literature cannot be extrapolated. So for any new material - electrolyte combination and machining conditions experiments need to be conducted to predict the effects of process parameters on machined geometry. For effective exploitation of ECM for machining SG Iron it is essential to develop models for predicting the nature of surface that will be generated. Two widely used methods for correlating controllable process parameters and surface roughness parameters are Design of Experiments and Artificial Neural Networks (ANN). The back–propagation algorithm is used widely as a learning algorithm in feed-forward multilayer neural network. A large data set is usually necessary to train the ANNs. However, generating a large number of data for training ANN is not only time consuming but very expensive. Hence to reduce the cost of developing NN models it is decided to train the network with only those thirteen data that are used for developing Box Behnken design based models. The three configurations of the ANN considered are 3-10-10-1, 3-20-20-20-1 and3-39-39-39-1. Because of the small data set the deviations noted between predictions obtained using Box-Behnken models and ANNs are high. Denoising is done in two stages using Multiscale Principal Component Analysis (PCA) and dropping the high frequency coefficients by filtering with Daubechies wavelet. The first stage denoising carried out using PCA has resulted in significant reduction in deviation (error). After second level denoising the errors have reduces further. Of the three network configurations studied lowest configuration gave the best results in majority of the cases and where as for the highest configuration, the denoising effect is small. Not only the error is reduced but the number of points with large errors has reduced substantially. The differences between the outputs from the neural network model and Box Behnken models are well within the confidence intervals calculated from ANOVA.

KEYWORDS: Artificial Neural Network, Box Behnken design, Denoising, Electrochemical Machining, Principal Component Analysis, SG Iron, Sa, Sq, Sz, Ssk, Sku, Smmr, Smvr, SHtp, Wavelet Analysis