MODELING AND OPTIMIZATION OF EDM SINKING PROCESSING MATERIAL AISI 4140 USING BACK PROPAGATION ARTIFICIAL NEURAL NETWORK-GENETIC ALGORITHM (BPANN-GA)

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ABSTRACT

High material removal rate (MRR) and low surface roughness are targets, which want to be reached by manufacturing process using EDM sinking. The slowest MRR will give good surface roughness. However, it makes process get slower and increase production cost. To solve this problem, the setting of process parameter, which gives maximum MRR and minimum surface roughness, is required.

An experiment in EDM sinking has been done using AISI 4140 and copper electrodes. Process parameters such as pulse current, on time, off time and gap voltage are varied. In addition, the $L_{18}(2^1x3^3)$ orthogonal array was applied because one of process parameters has two levels while the others have three levels. In this experiment, two replications were conducted to deal with the uncertainty. Based on the experiment results, back propagation artificial neural network (BPANN) was developed. Then, the process parameter setting, which gives the maximum MRR and the minimum surface roughness, was determined by genetic algorithm (GA).

It was shown in this research that the smallest MSE of BPANN was 0.00852, which was reached using 4-8-8-2, i.e., 4 inputs, 2 hidden layers with 8 neurons in each hidden layer, and 2 outputs. It was used logsig as activation function and trainrp as training type in the BPANN. By applying BPANN above, the parameters setting, which gives the maximum combination of MRR and the minimum surface roughness simultaneously is 9 Ampere of pulse current, on time 50 µs, off time 21 µs and gap voltage 25 V. Moreover, the MRR and surface roughness results are 34.135 mm^3/min and 4.85 µm.

Keywords: BPANN, genetic algorithm (GA), MRR, surface roughness.