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Material Removal Rate Prediction of Electrical Discharge Machining Process Using Artificial Neural Network

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Abstract: This article presents an Artificial Neural Network (ANN) architecture to model the Electrical Discharge Machining (EDM) process. It is aimed to develop the ANN model using an input-output pattern of raw data collected from an experimental of EDM process, whereas several research objectives have been outlined such as experimenting machining material for selected gap current, identifying machining parameters for ANN variables and selecting appropriate size of data selection. The experimental data (input variables) of copper-electrode and steel-workpiece is based on a selected gap current where pulse on time, pulse off time and sparking frequency have been chosen at optimum value of Material Removal Rate (MRR). In this paper, the result has significantly demonstrated that the ANN model is capable of predicting the MRR with low percentage prediction error when compared with the experimental result.

Key words: Electrical discharge machining, artificial neural network, material removal rate.

1. Introduction

Electrical Discharge Machining (EDM) is a process of material removal using an accurately controlled electrical discharge (spark) through a small gap (approximately 10 to 50 microns) filled with dielectric fluid between an electrode and a workpiece. The technique allows machining high-strength and wear-resistance materials such as high-strength alloys, polycrystalline diamond and ceramic (ultra-hard conductive material) since the hardness of the workpiece has no effect on the process. Unlike the traditional cutting and grinding processes, which depends on the force generated by a harder tool to remove the softer material workpiece, the EDM process is free from contact force and chatter vibration. Furthermore, EDM permits the machining to be done even after the hardening process. The EDM process has been used in high precision machining of metals, and to date, there are several different types of EDM systems that have been developed for a particular industrial application. EDM is widely used for making mold and dies and finishing parts for automotive industry, aerospace and surgical components [1]. Two principle types of EDM processes are the die sinking and the wire cut EDM process. Die sinking type EDM machine requires an electrode to machine the workpiece. Wire cut EDM machine uses a continuous wire as the electrode to cut the workpiece.

Rajurkar [2] explained some future trends study in EDM such as machining advanced materials, mirror surface finish using powder additives, ultrasonic-assisted EDM, control and automation. Other researchers conducted various investigations in process performance [3-8]. One of the field interests is to study the optimal selection of process parameters which will increase production rate considerably by reducing the machining time [9-10]. An optimum selection of machining parameters for the best process performance is still uncertain since EDM process is a

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