Predicting Material Removal Rate of Electrical Discharge Machining (EDM) using Artificial Neural Network for low I_{gap} current

Trias Andromeda, Electrical Engineering Dept., UTM, Malaysia
Azli Yahya, Electrical Engineering Dept., UTM, Malaysia
Nor Hisham bin Haji Khamis, Electrical Engineering Dept., UTM, Malaysia
trias1972@gmail.com, azli@fke.utm.my, hisham@fke.utm.my

Abstract :
This article presents a behavioral modeling of Electrical Discharge Machining (EDM) using Artificial Neural Network (ANN) to predict a material removal rate (MRR) for copper-electrode and steel-workpiece. It is aimed to develop a methodology using an input-output pattern of raw data collected from an EDM process to solve modeling problems. Therefore the present work describes the development and application of an Artificial Neural Network (ANN) to model an EDM process in order to predict the Material Removal Rate.

Keywords: Electrical Discharge machining(EDM), Artificial Neural Network(ANN), Modeling

1. Introduction

Electrical Discharge Machining (EDM) is one of the earliest non-conventional or non-traditional manufacturing processes. EDM is widely used for making mold and dies and finishing parts for automotive industry, aerospace and surgical components[1]. EDM erodes a workpiece material by using precisely controlled sparks that occur between an electrode and a workpiece in the presence of a dielectric fluid. Material is removed from the workpiece by repetitive current discharges between two electrodes, separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the 'tool' or 'electrode', while the other is called the workpiece-electrode, or 'workpiece'. EDM has been widely used for producing mould and dies. EDM differs from most chip-making machining operations. The electrode does not make a physical contact with the workpiece while machining, thus avoiding chatter vibration. 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 complex and stochastic process[11]. Determination of MRR has been reported by[9] where dimensional analysis technique is used to predict the MRR. In this paper, an artificial neural network as a behavioral model will be used to predict the MRR of EDM at low I_{gap} current.

2. Application of Artificial Neural Network for MRR of EDM

Artificial Neural Network (ANN) is an algorithm that imitates human being biological nervous systems. It has certain performance characteristics in common with biological neural networks[12]. The key element of this algorithm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working together to solve a specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. The main objective is to model EDM process for optimum operation representing a particular problem in the manufacturing environment where defining the