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Comparison Studies of Electrical Discharge Machining (EDM) Process Model for Low Gap Current

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Abstract. This paper aims to compare the material removal rate, $\dot{v}$ between a Dimensional Analysis (DA) model, an Artificial Neural Network (ANN) model and an experimental result for a low gap current of an Electrical Discharge Machining (EDM) process. The data analysis is based on a copper electrode and steel workpiece materials. The DA and ANN model that have been developed and reported earlier by authors are used to compare the material removal of EDM process. The result indicated that the ANN model provides better accuracy towards the experimental results.

Introduction

Electrical Discharge Machining (EDM) is one of the earliest non-conventional manufacturing processes. EDM is widely used for making mold and dies and finishing parts for automotive industry, aerospace and surgical components[1]. EDM process erodes workpiece material by using a precisely controlled sparks that occur between electrode and workpiece. EDM differs from most chip-making machining operations. In EDM, the electrode does not make a physical contact with the workpiece while machining, thus avoiding chatter vibration. 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. A research by [10] explained an application of neural network to predict the MRR. A low gap current, I_{gap} machining of EDM process for this article is considered at 4A, 6A, 8.5A and 12.5A. A cylindrical electrode with diameter of 20mm is used by [9,10] in their experiment. The maximum on-time used in the experimental analysis is 400μs. t_D depends on the open circuit gap voltage, the working gap length, the viscosity and the insulation properties of the dielectric fluid. A BP200 hydrocarbon mineral oil is used as an EDM dielectric fluid. "Open flushing" condition is applied to circulate the dielectric fluid between electrode and workpiece.

Summary of Dimensional Analysis model [10]

Application of dimensional analysis to material removal rate, $\dot{v}$ can be presented by an equation of the form,

$$\dot{V} = f(x_1, x_2, x_3 \ldots\ldots x_n) \tag{1}$$