Chapter 38
Identification of Optimal Process Parameters in Electro-Discharge Machining Using ANN and PSO

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ABSTRACT

Electrical Discharge Machining (EDM) process is a widely used machining process in several fabrication, construction and repair work applications. Considering Pulse-On Time, Pulse OFF time, Peak-Current and Gap voltage as the inputs and among all possible outputs, in the present work Material Removal Rate and Surface Roughness are considered as outputs. In order to reduce the number of experiments Design of Experiments (DOE) was undertaken using Orthogonal Array and later on the outputs were optimized using ANN and PSO. It was found that the results obtained from both the techniques were tallying with each other.

INTRODUCTION

Electrical Discharge Machining (EDM), in line with a book composed by Elman C. Jameson (Jameson 2001), happens to be non-conventional machining technique used for making the machined surface with the aid of electrical energy. The foremost vital advantage of victimising this system is that the absence of surface contact between the tool and the work piece that takes place within the presence of a dielectric medium (Paraffin oil). The Die Sinking EDM method was developed simultaneously in USA and USSR in the period of 2nd World War. During then a technique was required to process very hard materials used in military vehicles, equipment and ammunitions. Later on the method of Die Sinking EDM

was developed in various countries and was utilised in numerous Defences, Automotive, Aeronautics and many other industrial areas worldwide. The method is endlessly used for years to carry out varied very important experiments connected with the method of optimization. The process is used continuously from time to time to analyze the various machine parameters like Over-cut, Material removal rate, surface roughness, etc. Since multiple inputs are being used, hence optimizing these becomes essential for obtaining desired output. Out of the various parameters that may be thought of as the output of the machining operations, the material removal rate (MRR) and Surface roughness (SR) would be thought of for the current work as the factors specifically influences the standard, price of machining and therefore the machining hour rate.EDM is an essential machining process in many industries that give importance to precision and accuracy. Several researchers have studied EDM process considering different machining characteristics. Koshy et al. (1993) have studied EDM process for MRR, tool wear rate, relative electrode wear, corner reproduction accuracy and surface finish aspects using a rotating disk electrode and compared the results with a stationary electrode. It is seen that the effective flushing of the working gap improves MRR and surface finish. Zhang et al. (1997) have investigated MRR, surface roughness and diameter of discharge points in EDM on ceramics. From the experimental results, they have shown that MRR, surface roughness and also the diameter of discharge point directly varies with pulse-on time and discharge current. Lee and Li (2001) have investigated the result of machining parameters like the tool materials, tool polarity, gap voltage, peak current, pulse length, pulse interval and flushing on the machining characteristics, like MRR, surface end and relative tool wear in EDM of WC. It's ascertained that MRR usually decreases with the rise of gap voltage and surface roughness will increase with increasing peak current. Ramaswamy and Blunt (2002, 2004) have shown that the electrical energy is that the most dominant factor in modifying the surface texture, particularly the root mean square of peaks, the material volume in EDM of M300 tool steel. Puertas and Luis (2003) have shaped centre line average roughness value (Ra) and root mean sq. roughness price (Rq) in terms of current, pulse on time and Off time in EDM on soft steel (F-1110). It's seen that this intensity has the foremost influence on surface roughness and there's a strong interaction between this current intensity and also on the spark on time. Guu et al. (2003) have studied the results of different machining parameters on surface roughness in EDM of AISI D2 steel and being brought to a conclusion that surface roughness is inversely proportional to power input. Petropoulos et al. (2004) have stressed the relation between surface texture parameters and methodology parameters in EDM of Ck60 steel plates. They have thought of amplitude, spacing, hybrid, nonetheless as random methodology and type parameters that's perennial at each scale. Amorim and Weingaertner (2005) have targeting the terms of constant quantity influence of machining parameters on volumetric relative wear, MRR and surface roughness (Ra) in EDM of AISIP20 using copper tool electrodes. Puertas et al. (2005) have done a study on the influence of EDM processing parameter quality (current intensity, pulse time, duty cycle, gap voltage and dielectric flushing pressure) across 2 spacing parameters- mean spacing between peaks and therefore the range of peaks per cm in machining of siliconised or reaction-bonded carbide (SiSiC). From the results, it's seen that intensity, pulse time and duty cycle are most potent factors arousing result on the chosen responses. Guu (2005) has terminated that a lot of outstanding discharge energy leads to a lot of poor surface structure in EDM of AISI D2 steel. Yan et al. (2005) have examined scientifically the influences of the tactic parameters (dielectric sort, peak current and pulse duration) on MRR, conductor wear rate and surface roughness parameter in EDM of pure Ti metals. Keskin et al. (2006) have represented that surface roughness enhances with rise within the discharge length. Routara et al. (2007) have depicted the roughness models of EDM method for 3 dissimilar roughness parameters employing a methodology called response

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