WEDM USED FOR ANALYZING SPARK GAP WITH DIMENSIONAL ACCURACY AND SURFACE FINISH THROUGH QPSO

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ABSTRACT:

Wire electrical discharge machining (WEDM) is an expert on the thermal matching process that proficient in accuracy matching in the material of hard parts with complex shapes. Critical to controlled spark gap that achievement is required for surface finishes and part dimensions. Variables that affect the spark gap include the wire diameter, type and thickness of wire, surface finish requirements, part tolerance, and workpiece material thickness. In micromachining techniques leading an issue to comfort a metal removal rate stable in between the gap of microtool and workpiece. The process of WEDM technology is based on the occurrence of sparking in electrical discharge machining (EDM) widely accepted the techniques off the grid process by differentiating the spark which was generated at wire and spark of workpiece gap. The proposed algorithm of quantum behaved particle swarm optimization (QPSO) algorithms predict the removal of metal rate and the introduction of WEDM has developed for making tools and optimal to generate micro-scale parts with surface finish and dimensional accuracy with the highest degree. WEDM methods can be easily machined by using the mainstream machining process while the material was in sharp edges. Design of Taguchi's parameter approach which has been applied during the process of machining this procedure that saves time and eliminates the need for repeated experiments. Taguchi technique is mainly used in industries that minimize the variation process, improve the quality of the maintenance process, and decrease the number of experiments with the optimal process of energy. Experiment results were conducted to test the models and optimal and best results are obtained.

Keywords: Wire-EDM, Analysing Spark Gap, Surface Finish, Taguchi Method, Metal Removal Rate, QPSO Algorithm, Process Parameters.

I. INTRODUCTION

Wire electrical discharge machining (WEDM) plays an essential role in accuracy manufacturing. To achieve a precise workpiece with best surface quality, if necessary then added extra pedestrian finish cuts beside the rough cutting contour. An effort has been completed to expose the influence of machining performance of WEDM in finish cutting procedures of the machining parameter.

The surface roughness is gap width and the depth of the white layer machined workpiece surfaces is evaluated and measured. Based on the numerical analysis and Taguchi method the quality design is established distance between the wire periphery, pulse-on time and the workpiece surface are the significant factors moving the performance of machining.

II. LITERATURE REVIEW

J. T. Huang, et.al, controls the selection of optimal machining parameters for the Wire Electrical Discharge Machining (Wire-EDM) methods analyses by spreading over grey relational to Grey theory this can offer a solution for a structure in which the model of incomplete information or unsure.

S. S. Mahapatra and Amar Patnaik, has been established the relationship between the control elements and responses like kerf, SF, and MRR are recognized through nonlinear regression analysis and finally valid an optimal mathematical result.

Assarzadeh S. and Ghoreishi M. [5] offered a neural network based on the proposed approach for the optimal collection and prediction for the constraint process in die-sinking EDM. They established a back propagation neural network (BPNN) model to measure them in terms of three control parameters such as source voltage, current, and pulse period performance to be predicted.

III. METHODS OF ANALYSIS

The objective of the proposed research depicts various WEDM process parameters on the quality machining and achieves the optimal sets of parameter processing. Performance is established by mathematical models connecting to the machining parameter and using the QPSO algorithm was used to achieve the optimal machining parameters. The Taguchi technique has been applied to expression into the effects of the WEDM process optimized parameters.

Design of Experiment based on Taguchi Method

The Taguchi technique has been used to study the properties of the WEDM parameter process. WEDM of Taguchi's method described the proposed methodology is highly beneficial to manufacturing industries and also other areas such as tool-making industries, automobile and aerospace. These research summaries Taguchi's parameter design approach, which has been applied to optimize machining parameters during the machining process.

Effect on material removal rate

The MRR decreases with the increase in the pulse of time and increases with the increase in pulse on time and spark gap set voltage. This is because of the peak current prominent to a faster cutting rate and energy increases release with the pulse on time. As the decreases on pulse off time, the number of discharges within a certain period develops more which leads to a complex cutting rate on MRR methods.

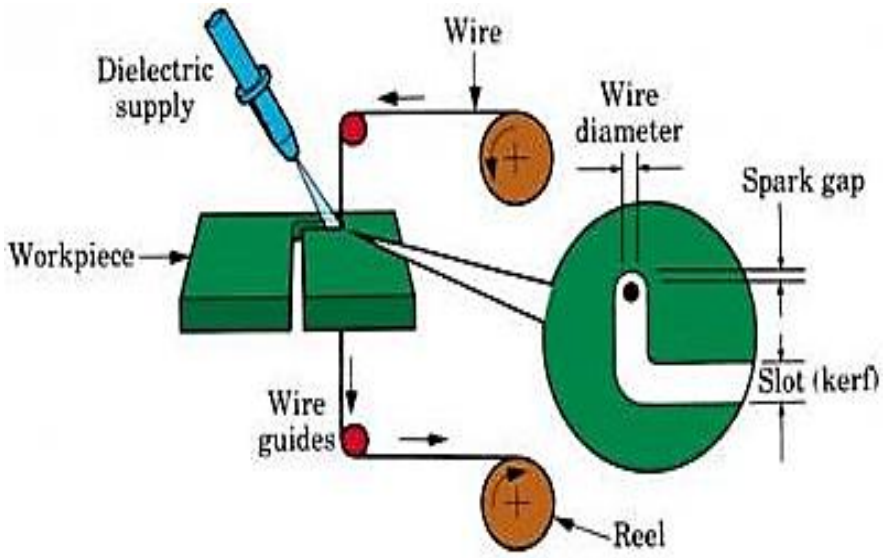


Figure 1: Material removal rate of WEDM method

Algorithm for Material Removal Rate

S=dw + (2*s)
MRR = vf*h*b
X[0]=0
del = vf/10
fori=1 to 10
X[i] = x[i-1] + del
Endfor
fori=0 to 10
Er[i] = x[i]*h*b

The research has been proposed from rough finish cutting operations planning a strategy of optimal WEDM development including the number of machining processes and their setting for each operation corresponding to the machining-parameters. Accurate dimension value and better quality of surface can be obtained with less machining time.

IV. RESULT AND DISCUSSION

Optimization

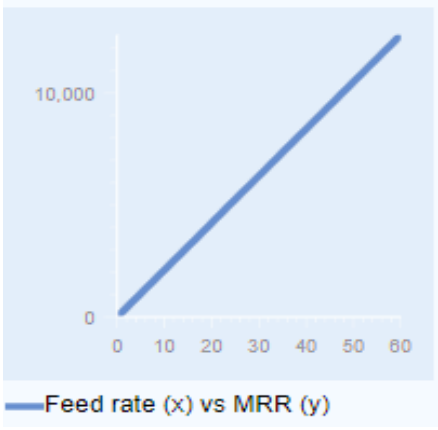
The traditional experimental design of parameter analysis is difficult to use and too complex. Moreover when increases number of machining parameters and huge numbers of experiments have to be carried out his is because the discharge energy increases with the peak current prominent to a pulse on time and faster cutting rate. Within the given period converts more when pulse time decreases the number of discharges which was indications to a complex cutting rate.

User Interface	A feed rate of wire into the Workpiece in mm/min (vf)	Workpiece thickness or height in mm (h)	Wire diameter in mm (dw)	The gap between wire and workpiece in mm (s)	Material removal rate (mm3/min) (MRR)
Input Variable (A)	50	10	5	2	4500.000
Input Variable (B)	60	30	3	2	12600.000
Input Variable (C)	75	20	4	1	9000.000
Input Variable (D)	20	60	5	8	25200.000

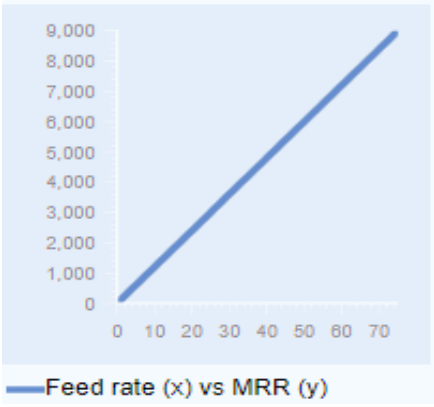
Table 1: Material removal rate of WEDM

The above table demonstrated the parameters of the spark gap analyzed from the workpiece for the optimal finishing surface of the WEDM by using the material removal rate of the input variable. The Workpiece thickness, the diameter of a wire, and the gap between the wire and workpiece are measured and executed the MRR parameter process table applied various input variable randomly and detect the rate of the MRR and illustrated the corresponding figures below.

(A)



(B)



(C)

(D)

Figure 2: Result of Feed Rate vessel MRR.

Accuracy of optimized parameters analyzing

The prediction accuracy of the proposed outline and existing outline can be analyzed through the value metal removal rate value processed and using quantum behaved particle swarm optimization (QPSO) algorithms the accuracy and surface finish metalwork is processed in the micro-scale level of electric discharge machining. The proposed system is compared with the existing algorithm of SVM for accuracy analysis.

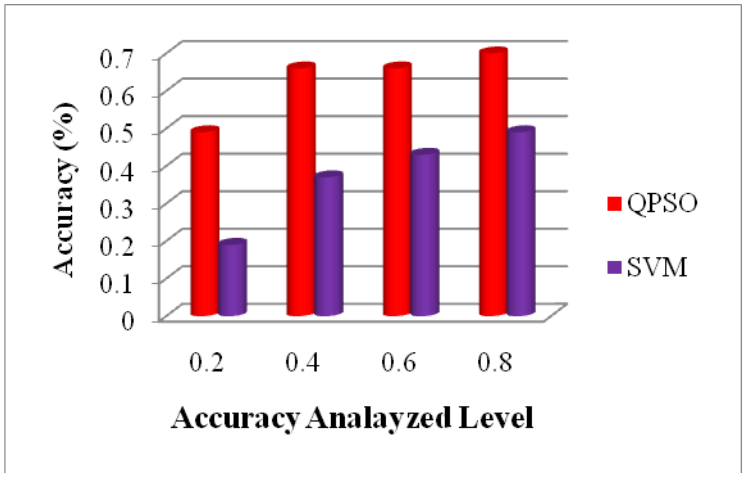


Figure 3: Accuracy analysis of MRR using the proposed algorithm

Error Rate

To estimate the effects of machining parameters on the performance characteristics MRR and to identify the performance features under the optimal machining parameters a specially designed Taguchi's method is used.

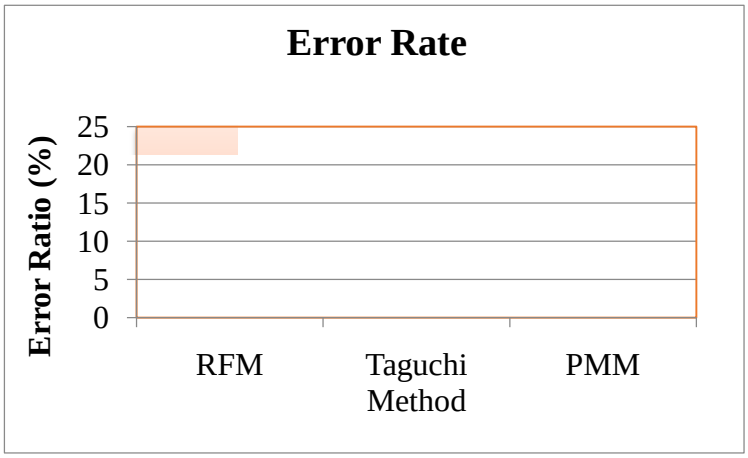


Figure 4: Error rate analyzing of proposed and existing methods

The error rate of the proposed and existing method has been illustrated in figure 4. The Response function modeling (RFM) and Performance measure modeling (PMM) approaches of the existing method compared with the proposed method. Compared with the existing method the Taguchi's gives a minimum error rate of processing.

V. CONCLUSION

The material removal rate (MRR) significantly increases with an increase in resistance of work material. Significant MRR was not notice able while changes in the Spark gap. Concerning Surface roughness and short pulse duration united with a high peak value can produce a better surface finish. Finally, the Taguchi method and QPSO algorithms have been used to compare the optimal level of spark gap parameters from the WEDM. The Taguchi's method widely used nowadays for producing complex geometrics with fitted tolerances on difficult to material of machines.

REFERENCES

[1]S. Dewangan, C.K. Biswas, “Optimisation of machining parameters using grey relation analysis for EDM with impulse flushing”, Int. J. Mechatronics Manuf. Syst. 6 (2) (2013) 144–158.

[2] D.F. Dauw, and L. Albert, “Two decades of wire-EDM evolution: a significant improvement of overall performance”, in Proceedings of the 10th International Symposium on Electromachining, ISEM 10, Magdeburg, Germany, 6–8 May 1992, pp. 300–320.

[3] J. T. Huang, and Y. S. Liao, “Optimization of machining parameters of Wire-EDM based on Grey relational and statistical analyses”, International Journal 41, 2013, 1707–1720.

[4] S. S. Mahapatra and Amar Patnaik, “Optimization of wire electrical discharge machining (WEDM) process parameters using Taguchi method”, The International Journal of Advanced Manufacturing Technology. 34, 2007 911-925.

[5] N. Tosun, C. Cajun, and H. Pihtili, “The effect of cutting parameters on wire crater sizes in wire EDM, International Journal of Advanced Manufacturing Technology”. 21, 2003, 857–865. Characteristics for WEDM of HCHCR and HARDOX.

[6] Indurkhya, G., and Rajurkar, K.P., 1992, “Artificial Neural NetworkApproach in Modeling of EDM Process”, Proceedings of Artificial NeuralNetworks in Engineering (ANNIE' 92) Conference, St.Louis, Missouri,U.S.A., 15-18 November, pp. 845-890.

[7] G. Wollenberg, H.-P. Schulze, and M. Läuter, “Process energy supply withpulses smaller than 200 ns and their thermal effects a Micro-EDM”,CAPE2001, Wuhan, China, 28–30 October 2001, Professional EngineeringPublishing Limited, London, UK.

[8] J.M. Jefferson, and P. Hariharan, “Machining performance of cryogenically treatedelectrodes in micro-electric discharge machining: A comparative experimentalstudy, Mater. Manuf”. Processes 28 (4) (2013) 397–402.

[9] Chaojiang Li et al. "Gap current-voltage characteristics of energy-saving pulse power generator for wire EDM". International Journal of Advanced Manufacturing Technology. 77 (2015): pages 1525–1531.

[10] Qu, J., Shih, A.J., and Scattergood, R.O., 2002, "Development of theCylindrical Wire Electrical Discharge Machining Process: Part I: Concept,Design, and Material Removal Rate", ASME Journal of ManufacturingScience and Engineering, Vol. 124, pp. 702-707.