IOSR Journal of Engineering
May. 2012, Vol. 2(5) pp: 1255-1258

DEVELOPMENT OF FUZZY MODEL FOR MICROSLOTS USING EDM

Mr. Alay shah[1], Prof. Bindu Pillai [2]

[1]([1]M.TECH.[CAD-CAM] Student, Chamos Matrusanstha Dept. of Mechanical Engineering Charotar University of Science & Technology Changa, Anand, Gujarat, India,

[2](Asst.Professor , Chamos Matrusanstha Dept. of Mechanical Engineering Charotar University of Science & Technology Changa, Anand, Gujarat, India,

ABSTRACT

Electrical Discharge Machining is a non-traditional method and can be used for the production of micro structures by micromachining. This paper discusses a fuzzy logic model for micro-drilling using EDM. The system uses fuzzy reasoning of the multiple performance characteristics (MPCI) of EDM like Peak Current, Pulse On time Rotational Speed and Pulse off time based on fuzzy logic. The fuzzy model uses fuzzy expert rules, triangular membership function for fuzzification and centroid area method for defuzzification processes using MATLAB fuzzy logic toolbox. The Experimental data used to develop the expert system was collected from the DOE developed for JOEMARS AZ50-JM32 for Hastelloy c 276 as work-piece material and Copper as electrode. The system is easy to use, provides a compact selection of tool based on expert rule and enables unskilled user to select necessary parameters which lead to less electrode wear, better surface quality and high erosion rate.

Keywords: - Fuzzy Logic, Micro-Drilling, EDM, MPCI

I. INTRODUCTION

Micro Electro discharge machining is a technology suitable miniaturized machining of metals and other conductive material, so similarity the principle of EDM. Electric discharge machining is a manufacturing process whereby a desired shape is obtained using electrical discharges.[2]
Micro electro discharge machine with used of fuzzy logic system where Fuzzy reasoning of the multiple performance characteristics has been developed based on fuzzy logic. But Multi-objective optimization is very difficult to solve due to the difficult problem. The process parameters interact in a complicated manner with various process outputs. so that interactive effect of process parameters are to be carefully selected for the most favorable process environment and give to desired level of output. For the optimization of complicated multiple-objective characteristics is transformed in to the optimization of single objective function which can be solved by Taguchi method.[1]

II. EXPERIMENTAL WORK AND EXPERIMENTAL DESIGN

The work material used is hastelloy c276 using Copper disc electrode with 0.7mm diameter and work performance on the JOEMARS AZ50-JM322.The downwards work piece has been controlled by servo control mechanism of EDM machine which maintained uniform sparking gap between work piece and tool. Commercial kerosene is used as dielectric medium for flushing purpose.

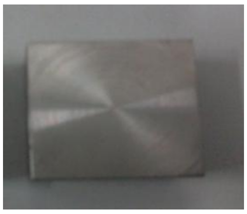

Fig.1 Rotary copper disc. Fig.2 Hastelloy as W/P

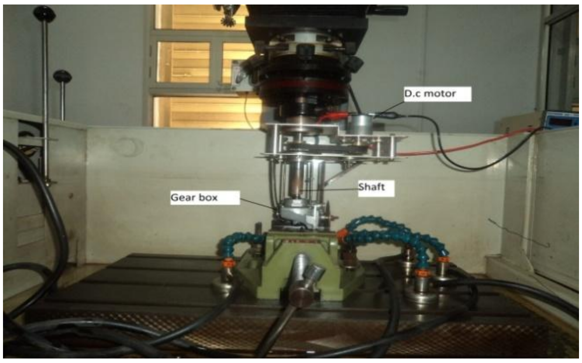

Fig.3 EDM machine [JOEMARS AZ50-JM3]

The experiment was designed based on L27 orthogonal array. And the process parameters chosen for the experiment are Rotational speed, Peak current, Pulse on time and Pulse off time. The machine conditions and number of levels of the parameter are selected as Given in table1.

Table1**:** Machining parameter used in Experiment

Factors	Machining Parameter	Levels		
		level 1	level 2	level 3
A	Speed	80	70	60
B	Peak current	28	21	17
C	Pulse on time	57	55	47
D	Pulse off time	42	40	32

III. PERFORMANCE MEASURE PROCEDUR

During the experimental reduction in weight of work piece or tool is calculated by obtaining weight difference of work piece or tool respectively before and after machining using Dolphin electronic digital weighing machine.It has a weighing range of 0-200 g with sensitivity of 0.01 gram.

$$MRR=\frac{W_{Jb}-W_{ja}}{t}$$

$$TWR=\frac{W_{Jb}-W_{ja}}{t}$$

Where,

Wjb=weight of work piece before machining.

Wja = Weight of work piece after machining.

t = Machining time.

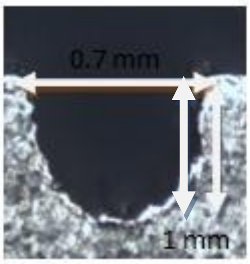

Fig 4. Machined groove on hastelloy

Correct experimental design contributes in optimization of analysis is to achieve high MRR and lower TWR in this Experimental work. Identification of significant parameters is done by using Taguchi design of experiments using Minitab R-16 software. The design of experiments using L-27 has been adopted for experiments.

IV. FUZZY LOGIC EXPERT SYSTEM

A Fuzzy rule based system consists of four parts: Knowledge base,fuzzifier, defuzzifier, and inference engine. In the first crisp value is applied on the fuzzifier. The fuzzifier convert in to imprecise quantity like large, medium, small etc. The inference engine then triggers the IF-THEN inference rule and synthesizes of output fuzzy value. The output generated by the inference block is always fuzzy in nature.So defuzzifier converted the fuzzifier value to crisp value. .

V. MULTIPLE PERFORMANCE CHARACTERISTICS

Initially the fuzzifier uses membership functions to fuzzify the (Signal-to-Noise) S/N ratio based on the experimental parameter combinations. To consider two different performance characteristics in the Taguchi method, the S/N ratios corresponding to the MRR and Tool wear rate have been processed by the fuzzy logic unit. Next, the interface engine performs a fuzzy reasoning on fuzzy rules to generate a fuzzy value. Finally the defuzzifier converts the fuzzy value into a MPCI.
The concept of fuzzy reasoning is described briefly based on the two input- one-output fuzzy logic unit. The fuzzy rule base consists of a group of if-then control rules with the two inputs, x1 and x2, and one output *y*, i.e.

• Rule 1: if x1 is A1 and x2 is B1 then *y* is C1 else

• Rule 2: if x1 is A2 and x2 is B2 then *y* is C2 else

• ……………………………………………

• ……………………………………………

• Rule n: if x1 is An and x2 is Bn then *y* is Cn.

Ai, *Bi*, and *Ci* are fuzzy subsets defined by the corresponding membership functions, i.e., µAi µBi and µCi . In this paper, three fuzzy subsets are assigned in the two inputs. Five fuzzy subsets are assigned in the output. Various degree of membership to the fuzzy sets is calculated based on the values of x1, *x2*, and *y*. Nine fuzzy rules are derived directly based on the fact that larger is the S/N ratio, the better is the performance characteristic.
By taking the max-min compositional operation , the fuzzy reasoning of these rules yields a fuzzy output. Supposing that *x1* and *x2* are the two input values of the fuzzy logic unit, the membership function of the output of fuzzy reasoning can be expressed as

$$\mu C0\ (y) = (\mu A1\ (x1) \wedge \mu B1\ (x2) \wedge \mu C1\ (y))\ v\ ..(\mu An\ (x1) \wedge \mu Bn\ (x2) \wedge \mu Cn\ (y))$$

where ^ is the minimum operation and v is the maximum operation.
Finally, a defuzzification method, called the center-of-gravity method is adapted here to transform the fuzzy inference output µ*C0* into a non-fuzzy value y0 that give MPCI.[1]

Table: 2 Input-Output And Fuzzy Logic Intervals

NO	System's linguistic variable	Variable	Linguistic Values	Fuzzy interval
1	Inputs	S/N ratio of MRR	Small	-60 to -45
			Medium	-55to-35
			Large	-45to -30
2		S/N ratio of Tool Wear Rate	Small	35to 45.
			Medium	40to 50
			Large	45to 55
3	Output	MPCI	Small	-0.5to 0.5
			Medium	0 to 1
			Large	0.5 to 1.5

VI: RESULTS

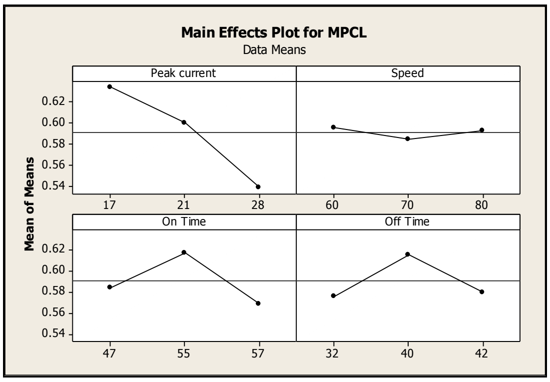

Fig:5 S/N ratio plot of MPCL(Evaluation of optimal setting)

Table: 3 Response table for signal to noise ratios

Level	Speed	Peak Current	Pulse On Time	Pulse Off Time
1	0.5952	0.6333	0.5845	0.5760
2	0.5843	0.5995	0.6180	0.6161
3	0.5921	0.5388	0.5691	0.5795
DELTA	0.0109	0.0946	0.0488	0.0401
RANK	**4**	**1**	**2**	**3**

Table: 4 Result for the MPCL

NO.	MPCL
1	0.5084
2	0.5303
3	0.5115
4	0.5580
5	0.6789
6	0.5845
7	0.5845
8	0.6745
9	0.5996
10	0.7230
11	0.6591
12	0.6019
13	0.5846
14	0.4890
15	0.6198
16	0.5501
17	0.5963
18	0.6191
19	0.7452
20	0.5110
21	0.5521
22	0.4642
23	0.6427
24	0.7505
25	0.6107
26	0.4769
27	0.5176

VII: CONCLUSION

Based on the experimental study and data analysis the fuzzy model predicts that the Peak current and Pulse on time are the most significant factors influencing overall process response (MPCI).

The results obtained from the fuzzy model shows a good confirmation with the results obtained from DOE. The fuzzy model provides a more precise selection of EDM process parameter for micro-drilling. The system is easy to use, provides a compact selection for tool based on expert rules and enables unskilled user to select necessary process parameters which lead to less electrode wear, better surface quality and high erosion rate. Also such an expert system can be used for automation of the process.

References

[1] Y.M.Puri&N.VDeshpands,"Simultaneous Optimization Of Multiple Quality Characteristics Of WEDM Based On Fuzzy Logic And Taguchi Technique",*Proceedings Of The Fifth Asia Industrial Engineering And Management System* Conference 2004.

[2] Nischint.Sahai And Mr.V.K.Singla "Mathematical Modelling Of Material Removal Rate And Hardness In Electric Discharge Machine By Doe Approach" [2009].

[3] Oguzhanyilmaz,Omer.Eyercioglu And Nabil. N.Z.Gindy,"A User-Friendly-Based System For The Selection Of Electro Discharge Machining Process Parameters",*Journal Of Materials Processing Technolog*y 172(2006)363-371

[4] Albert J.Shih And Scott F. Miller,"Fuzzy Logic Control Of Microhole Electrical Discharge Machining", *Journal Of Manufacturing Science Andengineering*, Dec2008

[5] Alay shah And Bindu Pillai" Development Of Fuzzy Model For Microdrilling Using Edm" International Conference on Information, Knowledge & Research in Engineering, Technology & Sciences-2012.