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ANALYSIS THE EFFECTS OF PROCESS PARAMETERS IN EN24 ALLOY STEEL DURING CNC TURNING BY USING MADM

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Abstract: Much of modern day machining is carried out by computer numerical control (CNC). In this research work an attempt has been made to analysis the effects of input parameters such as speed (rpm), feed (mm/rev), depth of cut (mm) and nose radius (mm) on output parameter such as material removal rate and surface roughness. The experiment was performed with different combination values of input parameter. Equal weightage has been assigned to all input parameter and a (Multi attribute decision making) MADM approach then performed to find out the best result.

Keywords- Machining, CNC, MADM

1. INTRODUCTION

Today, in this competitive market where material, time, quality, processes are the main factor that contributes towards profit incurred to the company. Now trend has been changed significantly from the past where only quality was considered as the main goal. But now profit and quality both are considered as main concern. Much of modern day machining is carried out by computer numerical control (CNC), in which computers are used to control the movement and operation of the mills, lathes, and other cutting machines. Turning is one of the most basic machining operation processes for material removal. The application multi-objective optimization technique has been used to optimize the cutting parameters in turning processes such as cutting depth, feed and speed. The output parameters tool life and operation time was optimized with help of Genetic Algorithms [1]. Taguchi Method has been applied to Optimize Different Machining Parameters of En24 Alloy Steel in CNC Turning. The process variables such as Speed, Feed, Depth of cut, Nose radius, Cutting environment (wet and dry) has been considered for optimizing surface roughness and material removal rates. The results shown that cutting environment was most in significant factor for both surface roughness and MRR [2]. An experimental investigation has been done with TiN coated cutting tools to examined the machining characteristics of different grades of EN materials in CNC turning process. An attempt has been made to optimum cutting conditions such surface roughness and maximum material removal rate by Taguchi method. It has been observed that speed was directly proportional to MRR in CNC turning [3]. The effects of input parameters such as speed, feed and depth of cut over Material Removal Rate (MRR) in turning of C34000 has been investigated. It has been concluded that cutting speed and feed rate was directly proportional to Material removal rate [4].

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II. RESEARCH METHODOLOGY

Step 1. Data Collection.

The data was collected through Experiment performed in workshop. The input parameters such as Speed (rpm), Feed (mm/rev.), D.OC (mm) and Nose radius and output parameters such as MRR, Surface roughness and time has been considered in experiment work. The value of experiment data is shown in Table 1.

Exp. No.	Speed (rpm)	Feed (mm/rev.)	D.OC (mm)	Nose radius	MRR (mm3/s)	Ra (µm)	Time (Sec)
1	1500	0.08	0.6	0.4	188	1.144	38
2	1500	0.1	0.8	0.8	314	0.936	32
3	1500	0.12	1	1.2	471	0.786	27
4	1600	0.08	0.8	1.2	268	0.576	38
5	1600	0.1	1	0.4	419	1.082	32
6	1600	0.12	0.6	0.8	301	0.502	26
7	1700	0.08	1	0.8	356	0.59	36
8	1700	0.1	0.6	1.2	267	0.51	30
9	1700	0.12	0.8	0.4	427	1.09	25

Step 2. Weightage to output parameter

The analytical Hierarchy process developed by [5] has been used to find out the priority weight of parameters.

Table 2: The pairwise comparison matrix

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	MRR	SR	Time	Priority weight
MRR	1	2	5	0.582
SR	1/2	1	3	0.309
Time	1/5	1/3	1	0.109

Step 3. Normalized matrix (TOPSIS Method, Hwawg and Yoon, 1981)
The normalized matrix has been computed by using following formula:

$$r_{ij} = a_{ij} / \sum_{i=1}^{n} (a_{ij})^2$$

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Table 3: Values of Normalized Matrix

	MRR	SR	Time
1	0.181	0.454	0.397
2	0.303	0.371	0.334
3	0.454	0.312	0.282
4	0.259	0.229	0.397
5	0.404	0.429	0.334
6	0.29	0.199	0.272
7	0.343	0.234	0.376
8	0.258	0.202	0.313
	0.412	0.432	0.261

Step 4. Weightage Matrix
Calculate the weighted normalized decision matrix by multiplying the normalized decision matrix by its associated weights.
$V_{ij} = W_j \times R_j$

Table 4: Values of Weightage Normalized Matrix

Exp. No.	MRR	SR	Time
1	0.105	0.14	0.043
2	0.176	0.115	0.037
3	0.264	0.096	0.031
4	0.15	0.071	0.043
5	0.235	0.133	0.037
6	0.169	0.062	0.03
7	0.2	0.072	0.041
8	0.15	0.063	0.034
9	0.24	0.134	0.029

Step 5:- Determine the positive-ideal (best) and negative-ideal (worst) solutions. The positive-ideal (best) and negative-ideal (worst) solutions can be expressed as;

$$V^+ = \{(\max_i (\sum V_{ij} / j \in J), (\min_i (\sum V_{ij} / j \in J') / \ i=1,2,3,\ldots\ldots,N\},$$
$$= \{V_1^+, V_2^+, V_3^+, V_4^+, \ldots\ldots V_M^+\}$$
$$V^- = \{(\min_i (\sum V_{ij} / j \in J), (\max_i (\sum V_{ij} / j \in J') / \ i=1,2,3,\ldots\ldots,N\},$$

Table 5: Values of positive-ideal and negative-ideal solutions.

	MRR	SR	Time
V+	0.264	0.062	0.029
V-	0.105	0.14	0.043

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Step 6: Calculate the separation measures

The separation of each alternative from the positive-ideal solution and negative-ideal solution is given by following equations. The values of separation measures are shown in Table 6.

$$S_1^+ = \{\sum_{j=1}^{M} (V_{ij} - V_j^+)^2\}^{0.5}$$

$$S_1^- = \{\sum_{j=1}^{M} (V_{ij} - V_j^-)^2\}^{0.5}$$

(i=1,2,3,.....N)

Table 6: Values of separation measures

Exp. No	S^+	S^-
1	0.178	8E-06
2	0.103	0.075
3	0.035	0.165
4	0.115	0.083
5	0.077	0.13
6	0.095	0.102
7	0.067	0.116
8	0.115	0.09
9	0.076	0.135

Step 7: Calculate the relative closeness

Exp. No	Relative closeness	Rank
1	4E-05	9
2	0.422	7
3	0.826	1
4	0.418	8
5	0.627	4
6	0.517	5
7	0.636	3
8	0.44	6
9	0.639	2

II. CONCLUSION

In this work two MADM approach has been implemented on experimental data to optimize the result. The AHP was implemented to compute the weight and TOPSIS so implemented to rank out the results. In this work four input parameters such as Speed (rpm), Feed (mm/rev.), D.OC (mm), Nose radius has been considered and influence of input parameters has

been investigated. The results shown that Speed 1500 (rpm), Feed 0.12 (mm/rev.), D.O.C (mm) 1 and Nose radius at 1.2 is the appropriate best input parameters setting.

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