Optimization of Process Parameters During CNC Turning by Using AHP & VIKOR Method

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Abstract

Machining is the basic and necessary operation for any manufacturing organization. Raman et al, 2013 made an attempt 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, surface roughness and time. Literature reveals that different MADM approach may provide different ranking to alternates for same problem. Thus to minimize the error while ranking alternates a VIKOR method has been used to rank out the alternatives and compared the result with existing result computed with TOPSIS method by Raman et al., 2013.

Keywords- Machining, CNC, MADM, VIKOR

1. Introduction

CNC turning play a significance role in growth of any manufacturing industry. CNC turning is very beneficial in turning of irregular shape of work piece especially in term of surface finish of final goods. CNC process is a group effort consists of CNC Programmer, designer, CNC operator. CNC programmer is familiar with different CNC codes. Turning process consists of different input and output process parameters. 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, surface roughness and time during CNC turning of EN 24 steel alloy [1]. An experimental study has been done to optimize the process parameter of AISI 1040 mild steel for surface roughness by using surface response method and genetic algorithm. The purposed study consists of three input parameters and three different surface roughness parameters. The result revealed that surface roughness parameter is directly proportional to feed and inversely proportional to spindle speed and depth of cut (Sahoo, 2011). An effort has been made to analyze the effect of input parameter such as Speed, Feed, Depth of cut, Nose radius, Cutting environment (wet and dry) on output parameter such as surface roughness and material removal rates. The Taguchi Method has been used to optimize the process parameters. It has been conclude nose radius affects the material removal rate by 40.68% [2]. The Taguchi Method was used to optimize the cutting parameter of CNC turning for surface finishing. The results revealed that the spindle speed is most significant factor in surface finish and at CBN Tools gives better surface finish compare to ceramic and carbide tools at all speeds, feeds and depth of cut [3]. The genetic algorithm has been used to optimize the process parameter on INCONEL 71 during CNC turning. The result shown that material removal rate is maximum at cutting speed 79.99m/min, feed rate 0.25mm/rev, depth of cut 0.1mm [4].

2. Research Methodology

Step 1. Experimental Data.

A group of student performed the experiment in the in workshop. The input parameters were recorded while performing experiment and MRR, Surface roughness of job was recorded with measuring instruments. The value of experiment data is shown in Appendix A.

Step 2. Compute weight by using AHP

The analytical Hierarchy process (Satty, 1980) has been used to find out the priority weight of parameters.

Table 1: The pairwise comparison matrix

	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. Implement VIKOR

The VIKOR (the Serbian name is 'Vlse Kriterijumska Optimizacija Kompromisno Resenje, which means multi-criteria optimization (MCO) and compromise solution) method was first established (Zeleny, 1982). It focuses on ranking and selecting the best alternative from a finite set of alternatives with conflicting criteria, and on proposing the compromise solution (one or more).

Step 1Determine the value of E_i and F_i

$$E_i = L_{1,\,i} = \sum_{j=1}^{M} w_j[(m_{ij})max - m_{ij}] \,/\, [(m_{ij)max} - (m_{ij})_{min}]$$

$$F_{i\,=}\, L_{\infty,\ I\,=}\, Max^{m} \text{ of } \{\, w_j[(m_{ij)max} - m_{ij}] \,/\, [(m_{ij)max} - (m_{ij})_{min}]$$

The values of Ei and Fi are shown in Table 2. The above mentioned Equation is only applicable to beneficial attributes and for non-beneficial attributes the term $[(m_{ij})_{max} - m_{ij}]$ is to be replaced by $[mij-(mij)_{min}]$.

Step 2 Calculate Pi values as follows:

$$Pi = v\{(Ei-E_{min})/(E_{max}-E_{min}))+(1-v)((Fi-F_{min})/(F_{max}-F_{min})$$

The values of Pi and ranking are shown in Table No. 2.

Table 2value of Ei and Fi

Exp. No.	Ei	Fi
1	1	0.582
2	0.59	0.323
3	0.153	0.137
4	0.562	0.417
5	0.445	0.279
6	0.358	0.35
7	0.371	0.237
8	0.465	0.42
9	0.373	0.283

Table 3value of Pi

Exp. No	Pi	Rank by VIKOR	Rank by TOPSIS
1	1	9	9
2	0.467159	6	7
3	0	1	1
4	0.556626	8	8
5	0.332036	4	4
6	0.359877	5	5
7	0.240608	2	3
8	0.501769	7	6
9	0.29425	3	2

3. Conclusion

In this work a MADM approach VIKOR 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. The computed result was compare by previous existing result with TOPSIS method.

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