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Optimization of Suface Roughness in Turning by Taguchi Method

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ABSTRACT: *Making technologies are currently formed as on basics of adaptability, self-ruled producing and level of automation. As the modernisation starts in making process, it is needed to update technologies in order to keep in competition. In such way that without any doubt cheaper products, shorter making time is needed .With the increase of machining parameters optimization is essential for production. In this paper an attempt is made to make a literature on optimizing machining parameters in turning processes by Taguchi method in MINITAB 17.0 software . Most of turning parameters were strongly analysed by using Taguchi testing method. Orthogonal order lines of Taguchi and the signal to noise (S/N) relation) is used to discover the most good selection levels and to get at the details of the effect of the turning parameters. The process parameter taken in this experiment is cutting speed, feed rate and depth of cut.*

I. Introduction

Turning operation is one of the machining processes. In turning the part is rotated while a single point cutting tool which is moved parallel to the axis of rotation. Turning can be also done on the external surface of the part as well as internally .The raw material is generally a work piece generated by other manufacturing processes such as casting, forging, extrusion, or drawing. The turning processes are typically carried out on a lathe and on a sophisticated CNC .There are four different types such as straight turning, taper turning, profiling or external grooving. Those types of turning processes can produce various shapes of materials such as straight, conical, curved, or grooved work piece. In general, turning uses single-point cutting tools. Each group of work piece materials has an optimum set of tools angles which have been developed by several experiments.

II. Literature Survey

D. Sai Chaitanya Kishore use a AI6061-TiC metal matrix composites as material to analyse the parameters such as cutting force and surface roughness in training. Taguchi method is used to perform the analysis. Material is made by the stir-casting process and SEM images are taken in order to examine the presence of TiC in AI6061-TiC metal matrix. Optimization study is performed by using MINITAB 16 software. S/N ratio is the final result of the Taguchi method. For this experiment lower the best signal to noise ratio is taken.The process parameters taken in this experiment were cutting speed, feed rate and depth of cut and the parameters which are analysed is cutting force and surface roughness. The main effect plots for S/N ratio of cutting force and surface roughness(Ra) is obtained by using MINITAB. The literature shows that depth of cut is more dependent parameter for the cutting force. And for the surface roughness, feed rate is dependant parameter. So changes in this can be evaluated by the given parameters. G. M Sayeed Ahmed optimizes the radial force in training process by using a statistical tool called Taguchi method. In this literature, mild steel is taken as the material and training tool is HSS tool. Force can be measured by Piezoelectric dynamometer. Experiment are done at various conditions at three different process parameters. The parameters are cutting speed, feed rate, depth. In this paper,L9 orthogonal array is taken and also smaller is better S/N ratio is used. Result from this experiment, optimization of feed force radial force is done. Fore feed force, SN ratio is lower for cutting speed. So, the cutting speed is more dependent parameter in feed force. For radial forces, the depth of cut is the dependent parameter and this is having the lower S/N ratio.

Ilhan Asilturk suggests that surface roughness(Ra ad Rz) as the parameters for the optimization. Ra and Rz are two types of surface roughness. In this paper, austenitic steel is used to analyse the parameters. CNC training machine is used for machining and roughness tester is used to measure Ra and Rz. For the optimization, L27 orthogonal array of Tagachi is used. The parameters which used for optimization are cutting speed, feed rate, depth of cut. By the analysis of values, S/N ratio will gives the output which shows that Ra is more dependent on the feed rate and also more optimised factor is cutting speed. Rz is also more dependent on the feed rate.

Carmita Camposeco-Negrete suggest some changes in training process in order to reduce the pollution. By adopting some measures, some raw materials can be saved. So by considering environmental issues, most of changes will be helpful to avoid these issues. In this paper, training parameters such as feed, depth of cut and cutting velocity is considered. Orthogonal array L9 is taken to optimise these parameters by using Tagachi method. By concerning environment issues, power and roughness is taken as the key parameters to be analysed. In this experiment, AISI6061 T6 aluminium cylindrical billets is used for training. S/N ratio smaller the better is taken in this experiment. By using MINITAB software, S/N ratio is plotted. By graph, power consumption per cycle is more dependent to the cutting velocity. And also software roughness is more related to the feed. Ashok Kumar sahoo shows some optimization of the composite material (AL/ SICP). Training of the composite material also similar to the other materials. The matrix will be aluminium and the reinforcement will be SICP. In this paper, surface roughness and flank wear is considered. The parameter used to analyse this factors is cutting speed, feed rate and depth of cut. L9 orthogonal array is used to examine the experiment. In this paper, taguchi method gives a S\N ratio which states that depth of cut has minimum significance on flank wear. surface roughness is more dependent on feed by the result given by graph.

III. Methodology

3.1taguchi Method

The Taguchi technique is a methodology for finding the optimum setting of the control factors to make the product or process insensitive to the noise factors. Taguchi's techniques have been used widely in engineering design, and can be applied to many aspects such as optimization, experimental design, sensitivity analysis, parameter estimation, model prediction, etc. The distinct idea of Taguchi's robust design that differs from the conventional experimental design is that of designing for the simultaneous modeling of both mean and variability. Taguchi based optimization technique has produced a unique and powerful optimization discipline that differs from traditional practices. While, traditional experimental design methods are sometimes too complex and time consuming, Taguchi methodology is a relatively simple method.

Taguchi method uses a special highly fractionated factorial designs and other types of fractional designs obtained from orthogonal arrays (OA) to study the entire experimental region of interest for experimenter with a small number of experiments. This reduces the time and costs of experiments, and additionally allows for an optimization of the process to be performed. The columns of an (OA) represent the experimental parameters to be optimized and the rows represent the individual trials (combinations of levels).

Traditionally, data from experiments is used to analyze the mean response. However, in Taguchi method the mean and the variance of the response (experimental result) at each setting of parameters in OA are combined into a single performance measure known as the signal-to-noise (*S/N*) ratio.

Depending on the criterion for the quality characteristic to be optimized, different *S/N* ratios can be chosen:

- Smaller-The-Better
- Larger-The-Better
- Nominal-The-Best

<u>Smaller – The –Better</u>

The Signal-To-Noise ratio for the Smaller-The-Better is:

S/N = -10 *log (mean square of the response)

$$S/N = -10\log_{10}\left(\frac{\sum y_i^2}{n}\right)$$

<u>Larger – The – Better</u>

The Signal-To-Noise ratio for the bigger-the-better is:

S/N = -10*log (mean square of the inverse of the response)

$$S/N = -10\log_{10}\left(\frac{1}{n}\sum\frac{1}{y_i^2}\right)$$

Where n= number of measurements in trial/row, in this case n=1, 2…, 9 and Y_i is the i^{th} measured value in a run/row. i =1, 2………

<u>Nominal – The – Better</u>

The S/N equation for the Nominal-The-Best is:
S/N = 10 * log (the square of the mean divided by the variance)

$$S / N = 10 \log_{10}\left(\frac{y^2}{s^2}\right)$$

IV. Experimental Procedure

Conventional HMT lathe machine has been used for the experiment having different parameter. Different range of speed can be chosen in machine by shifting the gears according to required speed. The Experiment has been conducted by Turning of mild steel, using HSS Tool and MINITAB 17.0 software (TRIAL) is used for optimisation. Surface roughness is measured by surface roughness tester.

Fig 1.Conventional HMT Lathe

V. Result And Discussion

In this study surface roughness of 9 experimental trials with repetition has measured for each sample. The results for surface roughness for each of the 9 experimental trials with repetition are given in Table 1.

Table 1 .Cutting parameters and their levels.

Factors	Level 1	Level 2	Level 3
Cutting speeds (m/min)	224	315	500
Feeds (mm/rev)	0.12	0.15	0.18
Depth of cut (mm)	.5	.75	1.0

S/N ratio is used to measure quality and it is used to analyse parameters.
Smaller the better S/N ratio is uesd to minimise the surface roughness value.

The Signal-To-Noise ratio for the Smaller-The-Better is:
S/N = -10 *log (mean square of the response)

$$S / N = -10 \log_{10}\left(\frac{\sum y_i^2}{n}\right)$$

where n is the number of repetitions and Yi is the measured value in a row.

5.1 Results For Surface Roughnes (Ra)

In this study surface roughness of 9 experimental trials with repetition has measured for each sample. The results for surface roughness for each of the 9 experimental trials with repetition are given in Table 2.

Table 2.Results for Surface Roughness

Trial No.	Speed (m/min)	Feed (mm/rev)	Depth of cut (mm)	Surface Roughness	S/N Ratio
1	224	.12	.5	0.894	0.973
2	224	.15	.75	2.840	-9.06
3	224	.18	1.0	7.598	-17.61
4	315	.12	.75	0.929	0.639
5	315	.15	1.0	2.872	-9.16
6	315	.18	.5	6.204	-15.85
7	500	.12	1.0	1.048	-.407
8	500	.15	.5	3.226	-10.17
9	500	.18	.75	7.133	-17.065

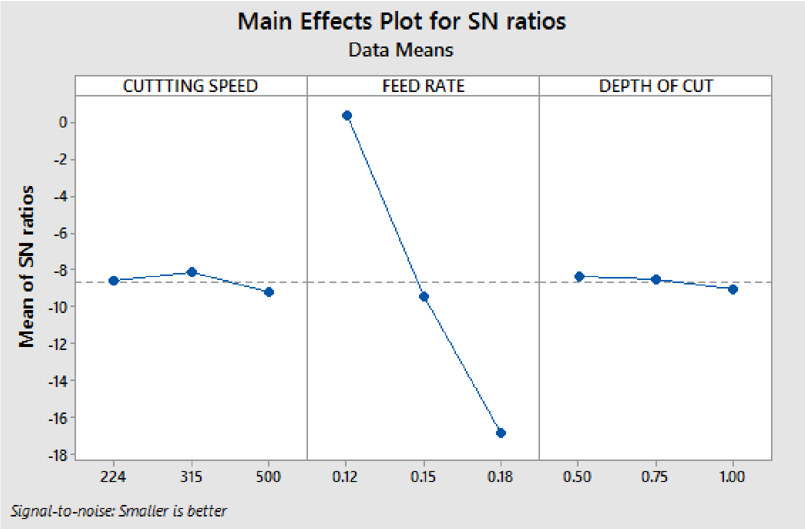

Fig 2 .Main Effects Plot for SN Ratios

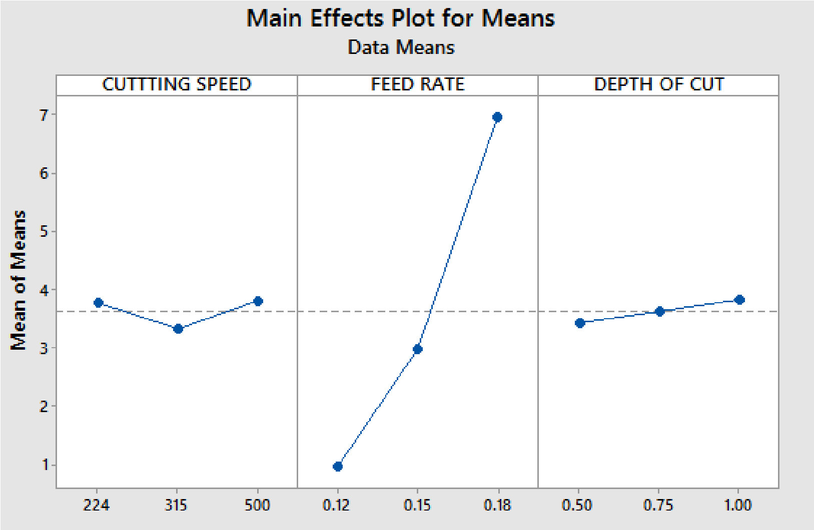

Fig3. Main Effects Plot for Means

In this study, turning is carried out with the input parameters considered as spindle speed, feed rate and depth of cut, and the response obtained is surface roughness. The parameters are optimized with respect to multiple performances in order to achieve a good quality. Optimization of the parameters was carried out using

Taguchi method. It was identified that feed rate (mm/rev)is the optimal parameter of turning parameters that influence surface roughness.

VI. Conclusion

The effect of turning process parameters (cutting speed, feed rate, depth of cut)on surface roughness were done experimentally done and also optimization by taguchi method were done. The significance of effect of parameters to response variables were determined and their effects are also analysed .This optimization can be used for every material available other than this material.

References

[1]. S.J. Raykara[1], D.M. D'Addonab[2], A.M. Manea[3],"Multi-objective optimization of high speed turning of Al 7075 using grey relational analysis" Procedia CIRP 33 (2015) 293 – 298

[2]. Guicai Zhang[1] and Changsheng Guo[2]. "Modeling of Cutting Force Distribution on Tool Edge in Turning Process" Procedia Manufacturing Volume 1, 2015, Pages 454–465

[3]. Sunil Dambhare[1], Samir Deshmukh[2] , Atul Borade c[3], Abhijeet Digalwar [4], Mangesh Phate[4]."Sustainability Issues in Turning Process: A Study in Indian Machining Industry". Procedia CIRP 26 (2015) 379 – 384.

[4]. Steininger Andreas[1], Bleicher Friedrich[2,] Siller Anton[3], Heat Dissipation in Turning Operations by Means of Internal Cooling Procedia Engineering 100 (2015) 1116 – 1123

[5]. Supriya Sahua[1] B.B.Choudhuryb[2] Optimization of Surface Roughness using Taguchi Methodology & Prediction of Tool Wear in Hard Turning Tools Materials Today: Proceedings 2 (2015) 2615 – 2623

[6]. Satyanarayana kosarajua[1], Satyam Chandrakerb[2] Taguchi analysis on cutting force and surface roughness in turning MDN350 steel Materials Today: Proceedings 2 (2015) 3388 – 3393

[7]. Carmita Camposeco-Negrete[1] Optimization of cutting parameters for minimizing energy consumption in turning of AISI 6061 T6 using Taguchi methodology and ANOVA .Journal of cleaner production 53(2013),195-203.

[8]. D. Philip Selvaraj[1] , P. Chandramohan[2] , M. Mohanraj[3] Optimization of surface roughness, cutting force and tool wear of nitrogen alloyed duplex stainless steel in a dry turning process using Taguchi method Measurement 49 (2014) 205–215

[9]. Ilhan Asiltürk[1] , Süleyman Neseli[2] . Multi response optimisation of CNC turning parameters via Taguchi method-based response surface analysis .measurement 45 (2012)785-794.