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CNC Turning Cutting Parameters Analysis Through Taguchi Technique for Non-Ferrous Materials

[1]Akanksha Shrivastava, [2]Dr Amit Bahekar

[1]PG Scholar, Department of Mechanical Engineering, SAGE UNIVERSITY, Indore

[2]Associate Professor, Department of Mechanical Engineering, SAGE UNIVERSITY, Indore

ABSTRACT

One of the most crucial factors in determining the functional performance of the components and, consequently, their fatigue life is the surface quality given by machining techniques. This project will present the outcomes of surface characterization of a part produced by high-speed turning with the best combinations of input parameters, including spindle speed (rpm), feed rate, depth of cut, material removal rate, adequate coolant flood, tool geometry, work piece clamping, material composition, chip formations, and the corresponding output size precision, circularity, and better surface finish. The Taguchi technique (orthogonal array) was adjusted for the trials in order to determine the significance of machining parameters in the investigation. The best possible set of cutting parameters was used in a confirmation test. The machined samples were examined for surface damage and other surface faults brought on by the machining techniques. In this study, the relationship between turning parameters and surface roughness is examined in order to determine the effects of different factors on the quality of the machined surface. By doing this, real production time is reduced, processing efficiency is implemented, and the amount of resources used in the actual production process is reduced, leading to a gain in process capability.

Keywords- Taguchi, Turning, Cutting factor, Optimization, Surface roughness

INTRODUCTION

In order to achieve the best machining parameters for CNC turning, Taguchi's parameter design is a systematic method for optimising a number of parameters in terms of performance, quality, and cost. Surface roughness is a crucial measure of a product's technological prowess and a factor that significantly affects production costs. Since a high-quality turned surface enhances fatigue strength, corrosion resistance, and creep life, the surface quality has a significant impact on the turning performance. In addition to surface friction, light reflection, lubricant retention, and electrical and thermal contact resistance, surface roughness also affects these factors. As a result, the intended surface roughness value for a specific part is frequently stated, and specialised methods are employed to achieve the specified finish.

OBJECTIVE OF WORK

The objectives of this study are to:

• Optimize the cutting process parameters, namely cutting speed, feed rate, spindle speed, and depth of cut.
• To determine the influence each process parameter has on surface quality.
• To increase surface roughness and dimension conformity in CNC turning operations while reducing variability in dimensional geometry.
• After the optimal process parameters are finalised, to set up a redundant manufacturing system to enhance process capabilities.

METHODOLOGY

The Taguchi L9 OA (Orthogonal Array) Design of Experiment approach has been chosen to examine the impact of the chosen parameters on the surface roughness of nonferrous material specimens. For this purpose, we conduct experiments and evaluate the outcomes to refine the strategy. Single-Objective Optimization Methodology by Taguchi: Steps preparation for experiments, Choose the criteria and level, use Orthogonal Array Selection (OA), and experiment with the outcomes. Analysis of Experiment Results, Statistical Analysis, and Experiment Results Interpretation.

DATA COLLECTION AND ANALYSIS OF DATA

Table 4.1 Orthogonal Array (Design Matrix) of Al

Worksheet 1 ***

↓	C1	C2	C3
	SPEED	FEED	DEPTH OF CUT
1	80	0.100	0.5
2	80	0.050	1.0
3	80	0.012	1.5
4	160	0.100	1.0
5	160	0.050	1.5
6	160	0.012	0.5
7	660	0.100	1.5
8	660	0.050	0.5
9	660	0.012	1.0

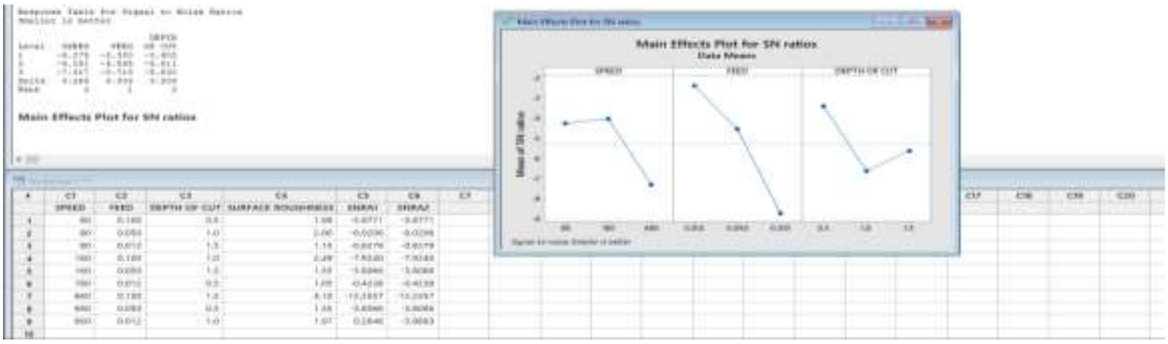

Figure 4.1 ANOVA for Aluminium

Table 4.2 Orthogonal Array (Design Matrix) of Brass

Worksheet 1 ***

↓	C1	C2	C3
	SPEED	FEED	DEPTH OF CUT
1	80	0.100	0.5
2	80	0.050	1.0
3	80	0.012	1.5
4	160	0.100	1.0
5	160	0.050	1.5
6	160	0.012	0.5
7	660	0.100	1.5
8	660	0.050	0.5
9	660	0.012	1.0

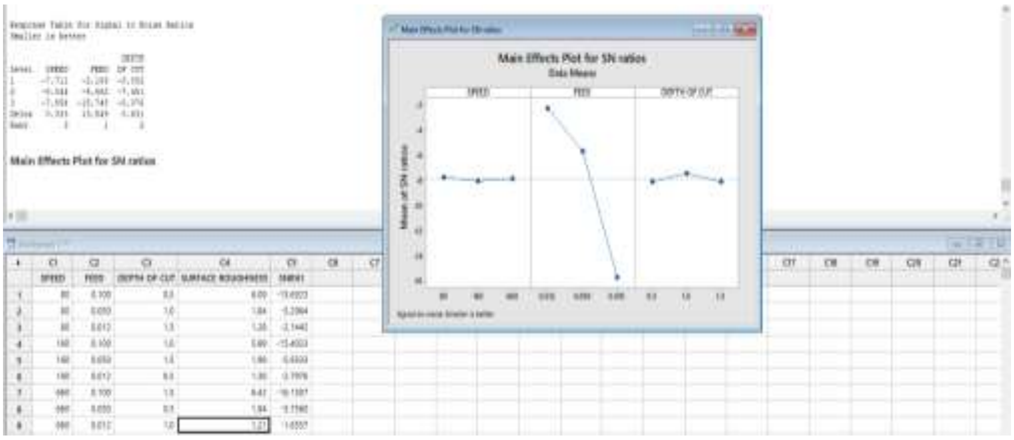

Figure 4.2 ANOVA for Brass

Table 4.3 Orthogonal Array (Design Matrix) of Copper

↓	C1 SPEED	C2 FEED	C3 DEPTH OF CUT
1	80	0.100	0.5
2	80	0.050	1.0
3	80	0.012	1.5
4	160	0.100	1.0
5	160	0.050	1.5
6	160	0.012	0.5
7	660	0.100	1.5
8	660	0.050	0.5
9	660	0.012	1.0

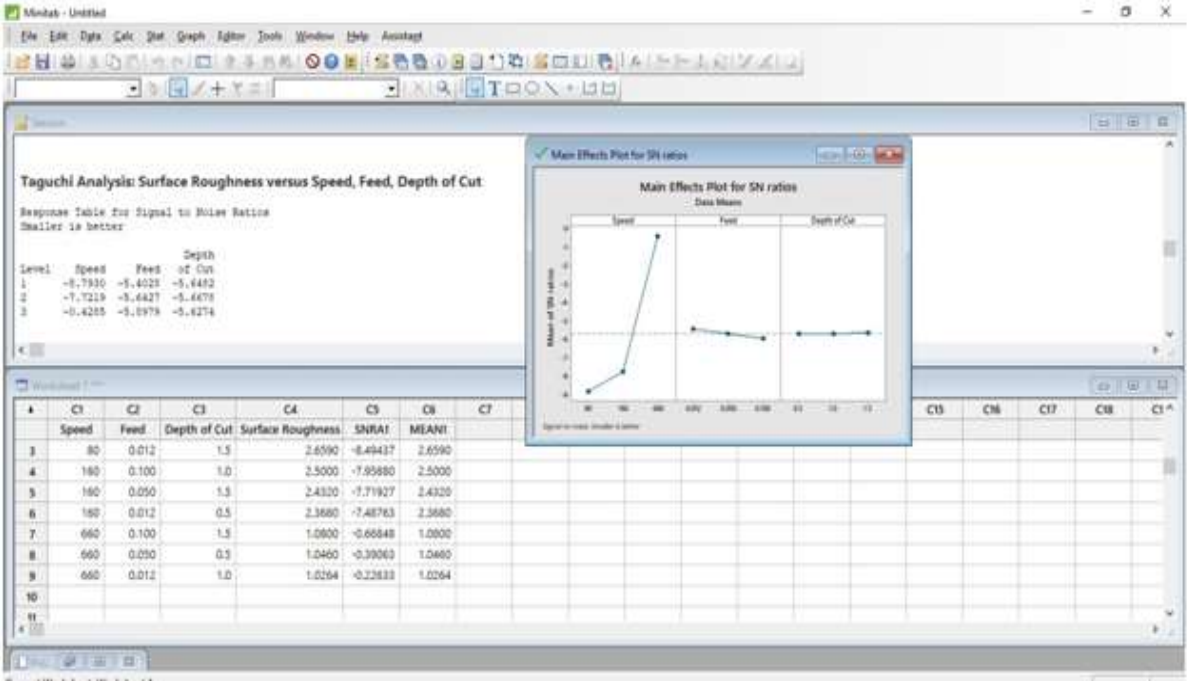

Figure 4.3 ANOVA for Copper

CONCLUSION

In order to achieve improved surface smoothness and geometrical dimensional compliance, this study modified process parameters, including cutting speed, feed, and depth of cut, during CNC turning operations of non-ferrous materials (Al, Cu, and Brass). Spindle speed, feed rate, and depth of cut were used as Control (input) Parameters in this experimental investigation, while surface roughness was used as a Response Parameter.

1) The optimal result for cutting aluminium was obtained with the input parameter settings of spindle speed 160 rpm, feed rate 0.012 mm/rev, and depth of cut 0.5 mm.
2) The spindle speed of 80 rpm, the feed rate of 0.012 mm/rev, and the depth of cut of 1.0 mm produced the best results for the brass material.
3) Spindle speed of 660 rpm, feed rate of 0.012 mm/rev, and depth of cut of 1.0 mm were the input parameter settings that produced the best results when Copper material was turned on a CNC lathe.

For Aluminum, Brass, and Copper specimens, the best combinations of levels and factors (cutting parameters) are A2 B1 C3, A3 B1 C2, and A1 B2 C3, respectively.

References

In this study we adopt following recommendations and reference books and articles from Journal, to fulfill the objective.

[1]. RoopaTulasi, Rajveer Singh,andMohammadIrshadAli 2018"Optimizing Surface Roughness in Turning Operation Using Taguchi Technique "Volume 4, Issue 8,,matpr, Pages 8624-8632.

[2]. SanchitKumar Khare, Sanjay Agarwal, and Shivam Srivastavaa 2018 "Analysis of Surface Roughness during Turning Operation by Taguchi Method "Volume 5, Issue 9, Part 3,Pages 19043-19048.

[3]. N.Rajesh.M.Yohan, P.Venkataramaiah,and M.Vani pallavi 2017"Optimization of Cutting Parameters for Minimization of Cutting Temperature and Surface Roughness in Turning of Al6061 Alloy"

[4]. João Eduardo Ribeiro, Manuel Braz Césara and Hernâni Lopes2017"Optimization of machining parameters to improve the surface quality"2nd International Conference on Structural Integrity, ICSI , 4-7 September 2017, Funchal, Madeira, Portugal.

[5]. George A Pentazopoulos,Anagnontis Touplazis, Constantine N Devid, Sagrisand Alkiviadis S. Paipetis 2018 "The machinability in turning mode of three lead-free brass alloys, CuZn42 (CW510L),CuZn38As (CW511L) and CuZn36 (C27450) was evaluated in comparison with a reference free-cutting."ELKEME Hellenic Research Centre for Metals S.A., 56th km Athens—Lamia National Road, 32011 Oinofyta, Greece.

[6]. AD. Dev Singh, and BN. Yadav Raju2018"Optimization Of Surface Roughness of CNC Step Turning Components Using Taguchi Method"International Journal for Research in Engineering Application & Management (IJREAM) ISSN : 2454-9150 Vol-04, Issue-03

[7]. M.A. Chowdhury, U.K. Debnath ,Md. Kamruzzaman, D.M. Nuruzzaman , and Md. Shahin Mia 2019 "Analysis and Optimization of Turned Surfaces of AISI 1060 using ANOVA and Regression" University Malaysia Pahang, Malaysia. Vol. 41, No. 1 (2019) 23-32.

[8]. Atitaya Chaijareenont and Somkiat Tangjitsitcharoen 2017"Monitoring of Surface Roughness in Aluminium Turning Process"ICFMM2017 IOP Publishing IOP Conf. Series: Materials Science and Engineering 303 (2017) 012013.

[9]. P.Jayaramana,and L. Mahesh kumar 2014"Multi-response Optimization of Machining Parameters of TurningAA6063 T6 Aluminium Alloy using Grey Relational Analysis in Taguchi Method"12th global congress on manufacturing and management, GCMM 2014.

[10]. A.Torresa Puertasa,and C.J. Luisa 2015"Surface roughness analysis on the dry turning of an Al-Cu alloy"The Manufacturing Engineering Society International Conference, MESIC 2015 Pamplona,Spain

[11]. N.M. Vaxevanidisa ,N.A. Fountasa, A. Koutsomichalisb, and J.D. Kechagiasc 2018"Experimental investigation of machinability parametersin turning of CuZn39Pb3 brass alloy"1st International Conference of the Greek Society of Experimental Mechanics of Materials, Greece.

[12]. Dr. C. J. Rao , Dr. D. Nageswara Rao, P. Srihari2013"Influence of cutting parameters on cutting force and surface finish inturning operation"International Conference On design and manufacturing, IConDM 2013

[13]. Puneet Bansal and Lokesh Upadhyay 2016"Effect of Turning Parameters on Tool Wear, Surface Roughness andMetal Removal Rate of Alumina Reinforced Aluminum Composite"3rd International Conference on Innovations in Automation and Mechatronics Engineering, ICIAME 2016.

[14]. Rajendra B and Deepak D 2015 "Optimization of Process Parameters for Increasing MaterialRemoval Rate for Turning Al6061 Using S/N ratio''International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST- 2015)

[15]. Ricardo Augusto Gonçalves and Márcio Bacci da Silva [2015] "Influence of Copper Content on 6351 Aluminum AlloyMachinability"Volume 1,Pages 683–69543rd Proceedings of the North American Manufacturing ResearchInstitution of SME,2015.

[16]. Debashree Goswami and Diganta Kalita [2016] "An Investigation of Multi CharacteristicOptimisation of Cutting Parameters in TurningOperation- A Theoretical Study" (IJETT) – Volume 37 Number 1- July 2016.

[17]. Hrelja Marko, Klancnik Simon, Irgolic Tomaz, Paulic Matej, Balic Joze and Brezocnik Miran][2013]"Turning Parameters Optimization using Particle SwarmOptimization"24th DAAAM International Symposium on Intelligent Manufacturing and Automation, 2013

[18]. N. Satheesh Kumar,Ajay Shetty, Ashay Shetty, Ananth K, and Harsha Shetty,[2012]"Effect of spindle speed and feed rate on surface roughness of CarbonSteels in CNC turning" International Conference on Modeling, Optimization and Computing (ICMOC 2012).

[19]. Dharindom Sonowal, Dhrupad Sarma, Parimal Bakul Barua and Thuleswar Nath [2017] "Taguchi Optimization of Cutting Parameters in Turning AISI1020 MS with M2 HSS Tool"IOP Conf. Series: Materials Science and Engineering 225 (2017) 012186, ICMAEM-2017

[20]. Gaurav Mishra, Arpit Srivastava, A. S. Verma, Ramendra Singh Niranjan [2017]"Optimization of Cutting Force, Feed Force and Material Removal Rate (MRR) in Turning of Inconel 718"International Journal of Science and Research (IJSR)ISSN (Online): 2319-7064 Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296.