 ISBN: 978-81-910765-1-6

OPTIMIZATION OF CNC TURNING PARAMETER OF EN8 STEEL BY TAGUCHI METHOD

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Abstract*— For the past more than one decade, mass production are done with aid of the computer numerical control (CNC) machines. the CNC codes are programmed and feed in the CNC to get the automated machining process. The main parameters considered for machining in any turning operations are cutting speed, feed and depth of cut. The finished component depends not only on the dimension accuracy and machining time but also on the surface finish.

***Keywords*— Include at least 5 keywords or phrases**

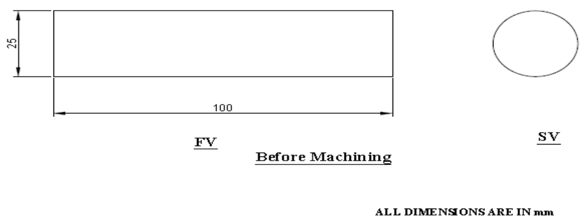
I. Introduction

Computer Numerical Control (CNC) machine plays vital role in the mass production. CNC machines are accurate, automated, and speed in nature. CNC machines are costly compared to other machine, so effective usage of machine is required. Selection of appropriate machining parameters is an important step in the process planning of machining operation. The present method of selection of machining parameters mainly depends either on previous work experience of process planner or thump rule or any machining data hand book. There is various traditional and non-traditional method of optimization to select the accurate machining parameters. Hence, in this present research, an attempt has been made to develop dedicated software using tag chi to suggest optimal cutting parameters for the required surface roughness in minimum possible machining time. This procedure was tested in EN8 material.

METHODOLOGY

- Design of experiment
- Pilot experiment
- Analysis of experimental values optimization of CNC machining

WORPIECE DESIGN



PROCESS OF MACHINING

Machining of EN8 steel material with the carbide tip tool are done in the CNC turning center. The CNC part programs are done Machining of EN8 steel material with the carbide tip tool are done in the CNC turning center. The CNC part programs are done as per the design of the experiment. From the table as the input parameter the machining are done and the machining time are calculated separately for each experiment. The surface roughness is measured by using the SJ-210 surface tester.

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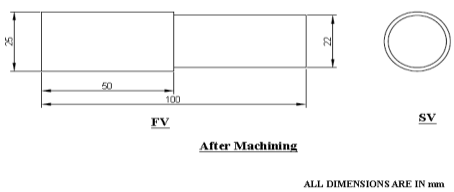
DESIGN OF WORKPIECE



A. The main cutting parameters that involves in the machining in the turning center are

B. Speed

C. Feed

D. Depth of cut.

The above three cutting parameters are the key factor for the machining properties of the work piece. The various constrained such as machining time, surface roughness, tool wear, material removal rate are based the selection of the cutting parameters

TAGUCHI METHOD

Dr. Taguchi of Nippon Telephones and Telegraph Company, Japan has developed a method based on "ORTHOGONAL ARRAY " experiments which gives much reduced " variance " for the experiment with " optimum settings " of control parameters. Thus, the marriage of Design of Experiments with optimization of control parameters to obtain BEST results is achieved in the Taguchi Method. "O orthogonal Arrays" (OA) provide a set of well balanced (minimum) experiments and Dr. Taguchi's Signal-to-Noise ratios (S/N), which are log functions of desired output, serve as objective functions for optimization, help in data analysis and prediction of optimum .

STEPS IN TAGUCHI METHODOLOGY:

Step-1: Identify the Main Function, Side Effects, and Failure Mode

Step-2: Identify the Noise Factors, Testing Conditions, And Quality Characteristics

Step-3: Identify the Objective Function to Be Optimized

Step-4: Identify the Control Factors and Their Levels

Step-5: Select the Orthogonal Array Matrix Experiment

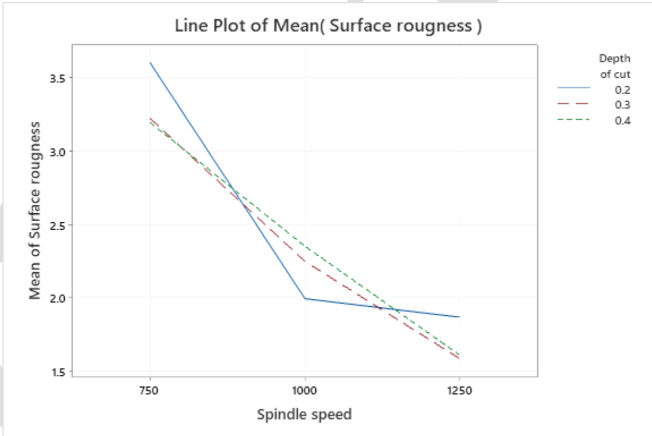


Fig. 1 A sample line graph using colors which contrast well both on screen and on a black-and-white hardcopy

ANALYSIS

- A factorial experiment can be analyzed using ANOVA or regression analysis.[5] It is relatively easy to estimate the main effect for a factor. To compute the main effect of a factor "A", subtract the average response of all experimental runs for which A was at its low (or first) level from the average response of all experimental runs for which A was at its high (or second) level.
- Other useful exploratory analysis tools for factorial experiments include main effects plots, interaction plots, and a normal probability plot of the estimated effects.
- When the factors are continuous, two-level factorial designs assume that the effects are linear. If a quadratic effect is expected for a

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factor, a more complicated experiment should be used, such as a central composite design. Optimization of factors that could have quadratic effects is the primary goal of response surface methodology.

- FORMATION OF DESIGN EXPERIMENTAL TABLE:

From the given range of the cutting parameters any three values are taken such that the value may be taken from lover limit, intermediate and upper limits. The values taken from the ranges are apply to the full factorial experimentation AND the 27 experiments are formed 33=27 experimental cutting parameters are formed

Trial No.	Spindle Speed	Depth of cut	Feed rate	Surface Roughness (μm)				Time	Temp
	rpm	mm	mm/min	Trial 1	Trial 2	Trial 3	Average	sec	°C
1.	750	0.2	0.1	3.226	3.253	3.089	3.189	63.6	32.5
2.	750	0.2	0.3	3.372	3.654	3.489	3.505	22.56	33.2
3.	750	0.2	0.5	4.284	4.021	4.032	4.112	13.79	31.7
4.	750	0.3	0.1	2.492	2.472	2.425	2.463	64.2	34.0
5.	750	0.3	0.3	2.518	2.810	2.887	2.738	22.69	35.2
6.	750	0.3	0.5	4.666	4.397	4.659	4.574	13.49	33.8
7.	750	0.4	0.1	2.606	2.511	2.656	2.591	64.2	35.5
8.	750	0.4	0.3	3.101	3.123	3.138	3.120	22.86	35.2
9.	750	0.4	0.5	3.929	3.667	3.805	3.800	13.63	38.3
10.	1000	0.2	0.1	1.659	1.968	1.912	1.846	50.93	38.2
11.	1000	0.2	0.3	1.666	1.381	1.439	1.495	16.75	33.5
12.	1000	0.2	0.5	2.676	2.638	2.626	2.646	10.01	32.5
13.	1000	0.3	0.1	1.651	1.786	1.893	1.776	50.59	40.1
14.	1000	0.3	0.3	1.767	1.635	1.080	1.765	16.82	40.7
15.	1000	0.3	0.5	3.003	3.452	3.171	3.208	10.24	33.7
16.	1000	0.4	0.1	1.838	1.962	1.893	1.897	50.68	69.4
17.	1000	0.4	0.3	2.051	2.108	2.177	2.112	17.16	50.1
18.	1000	0.4	0.5	3.007	3.109	3.034	3.050	10.14	94.6
19.	1250	0.2	0.1	1.701	1.511	1.912	1.708	40.43	37.2
20.	1250	0.2	0.3	1.102	1.167	1.363	1.210	13.54	36.8
21.	1250	0.2	0.5	2.869	2.872	2.829	2.690	8.04	34.3
22.	1250	0.3	0.1	1.207	1.153	1.290	1.216	40.49	66.0
23.	1250	0.3	0.3	1.106	1.146	1.010	1.087	13.61	39.3
24.	1250	0.3	0.5	2.497	2.434	2.448	2.459	8.07	35.2
25.	1250	0.4	0.1	1.007	1.089	1.240	1.112	40.46	96.2
26.	1250	0.4	0.3	1.112	1.106	1.137	1.118	13.61	93.6
27.	1250	0.4	0.5	2.709	2.649	2.462	2.604	7.56	73.7

Fig. 2 Example of an image with acceptable resolution

Surface roughness

Surface roughness, often shortened to roughness, is a component of surface texture. It is quantified by the deviations in the direction of the normal vector of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small, the surface is smooth. Roughness is typically considered to be the high-frequency, short wavelength component of a measured surface (see surface metrology). However, in practice it is often necessary to know both the amplitude and frequency to ensure that a surface is fit for a purpose.

CONCLUSIONS

In this research work, a new approach in selecting cutting parameters has been initiated in the manufacturing environment. The followings are

S.NO	CUTTING SPEED(m/min)	FEED (Mm/min)	DEPTH OF CUT
1	750	0.1	0.2
2	1000	0.3	0.3
3	1250	0.5	0.4

the summary of the results of the proposed methodology in finding optimal cutting parameters for achieving the desired surface roughness in minimum possible machining time.

1.Taguchi concept could able to predict the machining time for the proposed continuous profile in terms of accuracy as follows: Maximum Finishing Accuracy: 98.22% Minimum Finishing Accuracy: 82.45%

2.The proposed approach has eliminated the tedious process of selecting cutting parameters from the machining data hand book.

3. The dedicated software acts as the data base for the specific tool and work material combination.

4. Average deviation with respect to predicted and experimental machining time was observed to be 9.37 seconds (24.88 %).

5. Average deviation with respect to predicted and experimental surface roughness was observed to be 0.13 micron (11.43%).

6. The time taken to get the optimal cutting parameters for the desired surface roughness is Minitab the software. This is possible within the Taguchi Concept

7. The time involved in getting the optimal cutting parameters within the available tool and work material.

8. The developed software is user friendly and hence it can be very well installed in the computer interfaced with the CNC machine.
9. This approach shall be implemented in other machining operations such as milling, grinding etc.
10. There is a large scope for strengthening the developed database software by following the proposed methodology

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