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# Calculate Surface Finish Values With Different Parameters by CNC Turning Process Using Taguchi Method

Anthati Naveenkumar[1] B.Eswaraiah[2] Dr. M. Chandra Sekhar Reddy[3]

[1]M.Tech (AMS) Student, [2]Assistant professor, [3]Professor

Dept.of Mechanical Engineering, SV College of Engineering, Karakambadi Road, Triupati, Andhra Pradesh, India

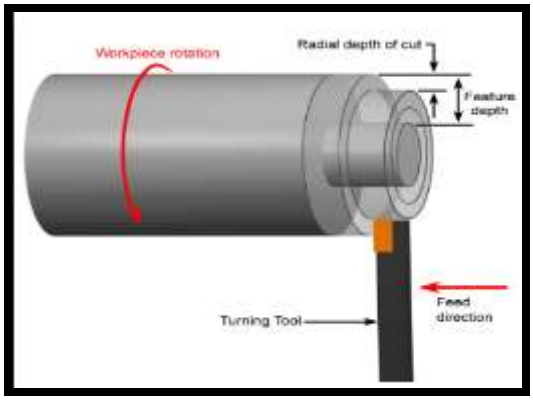
**Abstract:**

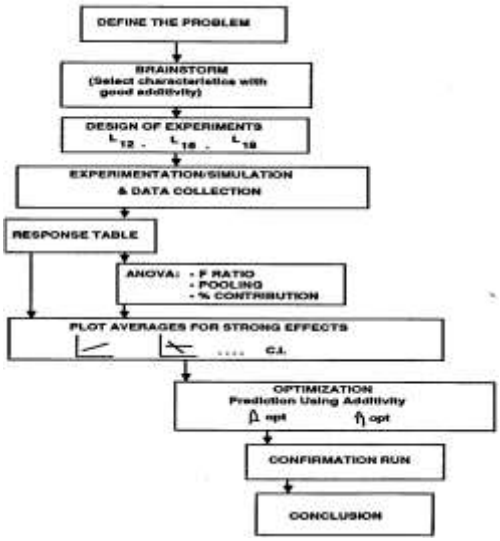
*Turning process is one of the most fundamental machining processes used in the manufacturing industry. The process of turning is influenced by many factors such as cutting velocity, feed rate, depth of cut, geometry of cutting tool, and cutting conditions etc., to name a few. In machining operations, achieving the desired surface quality of the machined product is really a challenging job. This is due to the fact that quality is highly influenced by process parameters directly or indirectly. In this thesis the effect of insert nose radius and machining parameters including cutting speed, feed rate and depth of cut on surface roughness) in a turning operation are investigated by using the Taguchi optimization method. 3D modeling done by PRO ENGINEER parametric software.*

**Keywords** -CNC Turing, Surface finish, taguchi optimization .

## 1. INTRODUCTION

The challenge of modern machining industries is mainly focused on the achievement of high quality, in terms of work piece dimensional accuracy, surface finish, high production rate, less wear on the cutting tools, economy of machining in terms of cost saving and increase the performance of the product with reduced environmental impact. The ratio between costs and quality of products in each production stage has to be monitored and immediate corrective actions have to be taken in case of Deviation from desired trend. Surface roughness measurement presents an important task in many engineering applications. Many life attributes can be also determined by how well the surface finish is Maintained. Machining operations have been the core of the manufacturing industry since the industrial revolution and the existing optimization researches for Computer Numerical Controlled (CNC) turning were either simulated within particular manufacturing circumstances or achieved through numerous frequent equipment operations. These conditions or manufacturing Circumstances are regarded as computing simulations and their applicability to real world industry is still uncertain and therefore, a general optimization scheme without equipment operations is deemed to be necessarily developed. Surface roughness is commonly considered as a major manufacturing goal for turning operations in many of the existing researches. The machining process on a CNC lathe is programmed. Many surface roughness prediction systems were designed using a variety of sensors including dynamometers for force and torque. Taguchi and Analysis Of Variance (ANOVA) can conveniently optimize the cutting parameters with several experimental runs well designed.



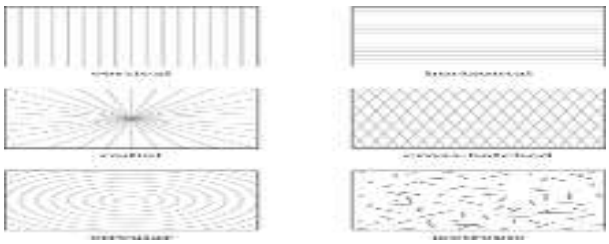

## TAGUCHI TECHNIQUE

Taguchi defines Quality Level of a product as the Total Loss incurred by society due to failure of a product to perform as desired when it deviates from the delivered target performance levels. This includes costs associated with poor performance, operating costs (which changes as a **Taguchi Methods**

Help companies to perform the Quality Fix!, Quality problems are due to Noises in the product or process system, Noise is any undesirable effect that increases variability, Conduct extensive Problem Analyses, Employ Inter-disciplinary Teams, Perform Designed Experimental Analyses, Evaluate Experiments using ANOVA and Signal-to noise techniques product ages) and any added expenses due to harmful side effects of the product in use.

## SURFACE FINISH

Surface finish, also known a surface texture or surface topography, is the nature of a surface as defined by the 3 characteristics oflay, surface roughness, and waviness. It comprises the small local deviations of a surface from the perfectly flat ideal (a true plane).Surface texture is one of the important factors that control friction and transfer layer formation during sliding. Each manufacturing process (such as the many kinds of machining) produces a surface texture. The process is usually optimized to ensure that the resulting texture is usable. If necessary, an additional process will be added to modify the initial texture. The latter process may be grinding (abrasive cutting), polishing, lapping, abrasive blasting, honing, electrical discharge machining (EDM), milling,lithography, industrial etching/chemical milling, laser texturing, or other processes.



## 2. LITERATURE SURVEY

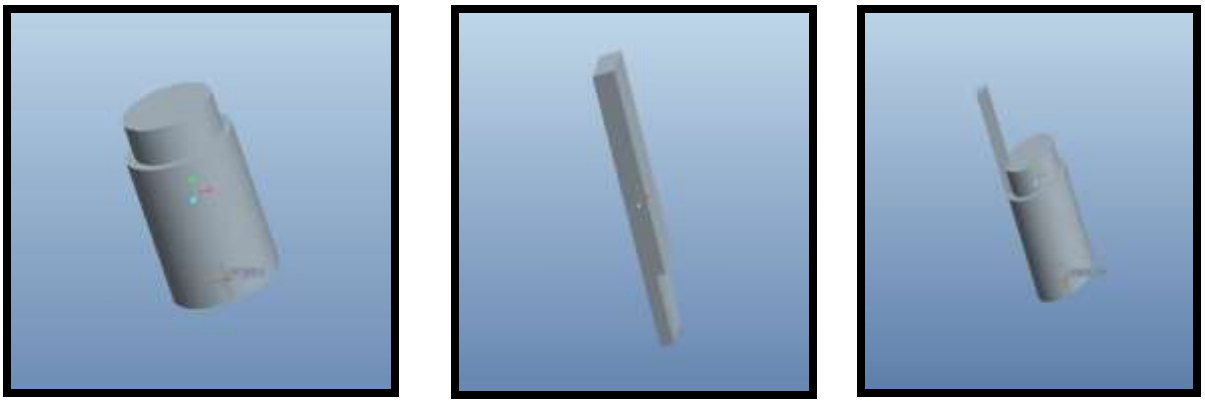
Using the Response Surface Method to Optimize the Turning Process of AISI 12L14 SteelBy Karin Kandananond, Faculty of Industrial Technology, Rajabhat University Valaya-Alongkorn, Prathumthani 13180, Thailand, Received 28 July 2010; Accepted 4 December 2010.The purpose of this paper is to determine the optimal cutting conditions for surface roughness in a turning process. This process is performed in the final assembly department at a manufacturing company that supplies fluid dynamic bearing (FDB) spindle motors for hard disk drives (HDDs). The workpieces used were the sleeves of FDB motors made of ferritic stainless steel, grade AISI 12L14. The optimized settings of key machining factors, depth of cut, spindle speed, and feed rate on the surface roughness of the sleeve were determined using the response surface methodology (RSM).

## METHODOLOGY

In this work, experimental results were used for Optimization of input machining parameters speed, feed, and depth of cut using Taguchi Technique for the response Surface Roughness. ANOVA is also used for Predicting the influence of various parameters on Rz.

## 3D MODEL OF WORK PIECE &CUTTING TOOL

WORK PIECE
CUTTING TOOL
ASSEMBLY



## Materials

**Work piece** –EN 31 steel

**Cutting tool** –carbide tool

## ORTHOGONAL ARRAYS

An orthogonal array is a type of experiment where the columns for the independent variables are "orthogonal" to one another. Orthogonal arrays are employed to study the effect of several control factors. Orthogonal arrays are used to investigate quality. Orthogonal arrays are not unique to Taguchi. They were discovered considerably earlier (Bendell, 1998). However Taguchi has simplified their use by providing tabulated sets of standard orthogonal arrays and corresponding linear graphs to fit specific projects (Taguchi and Kenishi, 1987; and ASI, 1989). A L9 Orthogonal array is shown in the

### Selection of Orthogonal Array

To select an appropriate orthogonal array for the experiments, the total degrees of freedom need to be computed. The degrees of freedom re defined as the number of comparison between design parameters that need to be made to determine which level is better ands pecifically

how much better it is. For example, a three-level design parameter counts for two degrees of freedom. The degrees of freedom associated with the interaction between two design parameters are given by the product of the degrees of freedom for the two design parameters.

TABLE 1:PROCESS PARAMETERS AND THEIR LEVELS

| PROCESS PARAMETERS | LEVEL1 | LEVEL2 | LEVEL3 |
|---|---|---|---|
| CUTTING SPEED(rpm) | 600 | 1200 | 1800 |
| FEED RATE (mm/rev) | 200 | 250 | 300 |
| DEPTH OF CUT(mm) | 0.4 | 0.5 | 0.6 |

TABLE 2: ORTHOGONAL ARRAY WITH PROCESS PARAMETERS

| JOB NO. | SPINDLE SPEED (rpm) | FEED RATE (mm/min) | DEPTH OF CUT (mm) |
|---|---|---|---|
| 1 | 600 | 200 | 0.4 |
| 2 | 600 | 250 | 0.5 |
| 3 | 600 | 300 | 0.6 |
| 4 | 1200 | 200 | 0.4 |
| 5 | 1200 | 250 | 0.5 |
| 6 | 1200 | 300 | 0.6 |
| 7 | 1800 | 200 | 0.4 |
| 8 | 1800 | 250 | 0.5 |
| 9 | 1800 | 300 | 0.6 |

## EXPERMENTAL SETUP

The work piece material selected for investigation is the EN 31 STEEL. The cutting experiments were carried out on Work piece by CNC Lathe under different cutting conditions are shown in Table 2.Experimental data of EN 31 STEEL which was used in experiments as shown in the Table

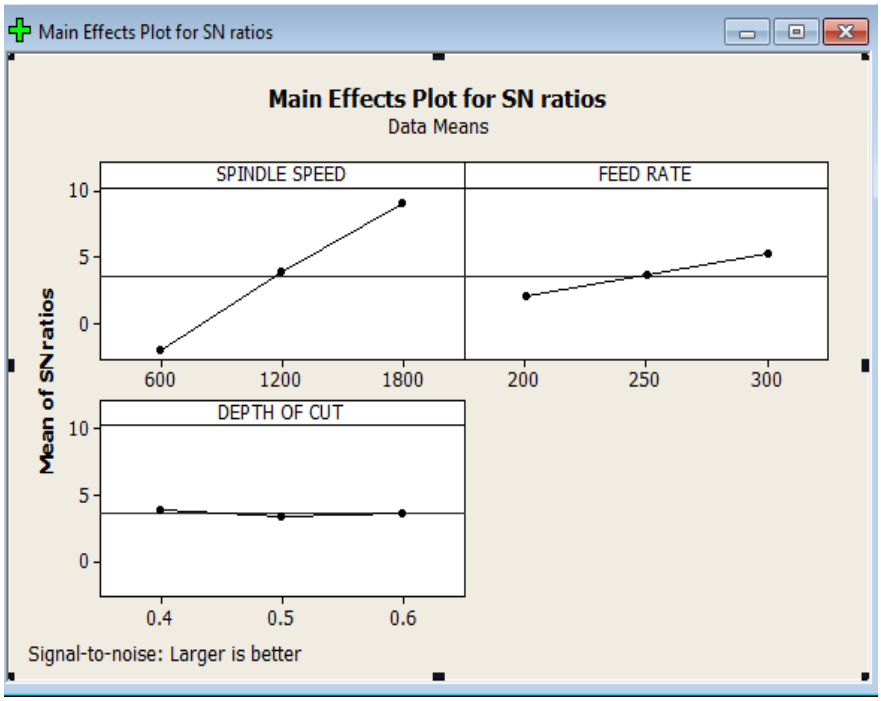
TABLE 3: EXPERIMENTAL DATA FOR 3 PARAMETERS ON Rz, FOR CARBIDE TOOL

| JOB NO. | SPINDLE SPEED (rpm) | FEED RATE (mm/min) | DEPTH OF CUT (mm) | Surface finish ($R_a$) μm |
|---|---|---|---|---|
| 1 | 600 | 200 | 0.4 | 0.62 |
| 2 | 600 | 250 | 0.5 | 0.78 |
| 3 | 600 | 300 | 0.6 | 0.91 |
| 4 | 1200 | 200 | 0.4 | 1.21 |
| 5 | 1200 | 250 | 0.5 | 1.46 |
| 6 | 1200 | 300 | 0.6 | 1.94 |
| 7 | 1800 | 200 | 0.4 | 2.41 |
| 8 | 1800 | 250 | 0.5 | 2.84 |
| 9 | 1800 | 300 | 0.6 | 3.12 |

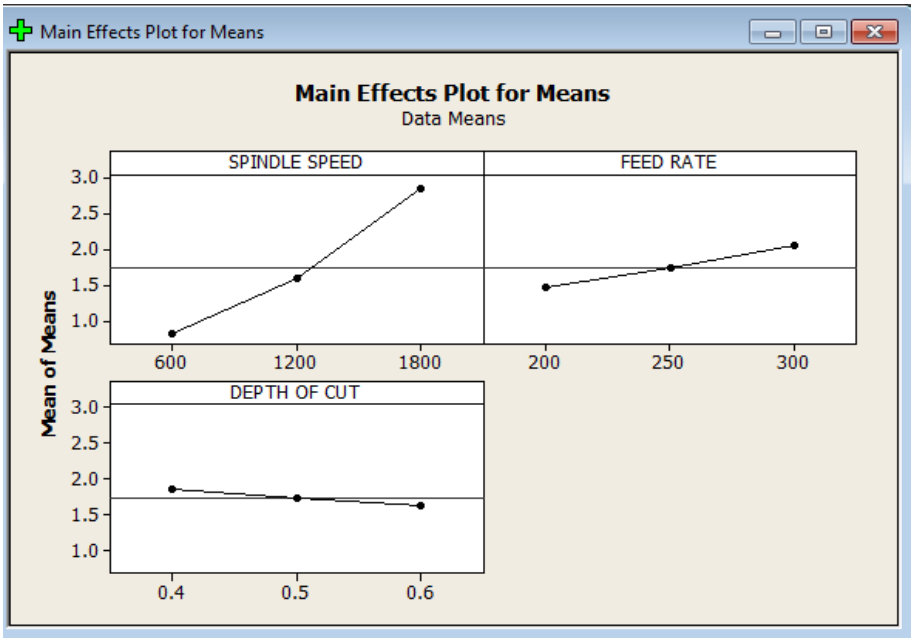
## RESULTS AND DISCUSSION

In the Taguchi method the results of the experiments are analyzed to achieve one or more of the following three objectives. To establish the best or the optimum condition for a product or a process. To Studying the main effects of each of the factors identifies the optimum condition (Figures 2 and 3). The process involves minor arithmetic manipulation of the numerical result and usually can be done with the help of a simple calculator. The main effects indicate the general trend of the influence of the factors. Knowing the characteristic, i.e., whether a higher or lower value produces the preferred result, the levels of the factors, which are expected to produce the best results, can be predicted. Estimate the contribution of individual factors. To estimate the response under the optimum conditions. The knowledge of the contribution of individual factors is the key to deciding the nature of the control to be established on a production process. The analysis of variance (ANOVA) is the statistical treatment most commonly applied to the results of the experiment to determine the percent contribution of each factor. Study of the ANOVA table for a given analysis helps to determine which of the factors need control and which do not. In this study, an L9 Orthogonal array with was used.

EFFECT OF TURNING PARAMETERS ON FORCE FOR S/N RATIO




EFFECT OF TURNING PARAMETERS ON FORCE FOR MEANS




Taguchi method stresses the importance of studying the response variation using the signal–to–noise (S/N) ratio, resulting in minimization of quality characteristic variation due to uncontrollable parameter. The cutting force is considered as the quality characteristic with the concept of "the smaller-the-better". The S/N ratio for the smaller-the-better is:

$S/N = -10 * \log(\Sigma(Y^2)/n))$

Where n is the number of measurements in a trial/row, in this case, n=1 and y is the measured value in a run/row. The S/N ratio values are calculated by taking into consideration above Eqn. with the help of software Minitab 17.

The force values measured from the experiments and their corresponding S/N ratio values are listed in Table

## CONCLUSION

Experimental work is conducted by considering the above parameters. By observing the experimental results and by taguchi, the following conclusions can be made To minimize the cutting forces, the optimal parameters are spindle speed – 600rpm, feed rate – 200mm/min and depth of cut – 0.4mm.To get better surface finish, the optimal parameters are spindle speed – 1800rpm, feed rate – 300mm/min and depth of cut – 0.6mm.To maximize material removal rate, the optimal parameters are spindle speed – 600rpm, feed rate – 200mm/min and depth of cut – 0.6mm.. 3D modeling is done in Pro/Engineer.

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