International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ☵ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10508

# SINGLE OBJECTIVE OPTIMIZATION OF MACHINING PARAMETERS IN TURNING OFAISI1018 STEEL USING TAGUCHI METHOD

**Hitesh Hanumant Aher[1], Ashish Dhananjay Giri[2], Sanket Maruti Hajare[3], Vijay Balu Upade[4], Prof. Raju Singh[5]**

UG Student, Dept. of Mechanical Engineering, PK Technical Campus Khadachiwadi, Chakan Pune, Maharashtra[1-4]

Assistant Professor, Dept Mechanical Engineering, PK Technical Campus Khadachiwadi,Chakan Pune, Maharashtra[5]

**Abstract**: Each manufacturing business in the competitive sector aims to produce a low-cost, high-quality product in a short amount of time to meet client demand. For this, automated and adaptable production methods, as well as computerised numerical control (CNC) equipment capable of high precision and short processing times, are used. Turning operations employing CNC (computer numerical controlled) equipment are of significant interest in today's era of mass production. In this project, the Taguchi technique was used with an L16 Orthogonal Array to calculate three parameters: RPM, Feed, and Cut Depth. For each of these characteristics, four alternative levels have been discovered and utilised to conduct the turning operation on a 2D CNC lathe in order to minimise the Surface roughness value. The machining material was M.S. AISI1018 bar using a carbide cutting tool. The purpose is to generate a combination of optimal cutting settings based on the surface roughness value. This research provides an optimization strategy for minimising Surface roughness value utilising orthogonal array (L16), and the results of this study back it up. As a result of the provided ideal parameters, it is feasible to improve machining process efficiency while lowering production costs in an automated manufacturing environment.

## I. INTRODUCTION

In competition industry, each manufacturing company wants to manufacture low cost and high quality product in a short time to full fill customer demand. Automated and flexible manufacturing systems are employed for that purpose along with computerized numerical control (CNC) machines that are capable of achieving high accuracy and very low processing time. In a turning operation, it is important task to select cutting parameter for achieving high cutting performance. Usually, the desired cutting parameters are determined based on experience or by use of handbook. Cutting parameters are reflected on surface roughness, surface texture and dimensional deviations of the product. Surface roughness, which is used to determine and to evaluate the quality of a product, is one of the major quality attributes of a turning product.

Surface roughness is a measure of the technological quality of a product and a factor that greatly influences manufacturing cost. It described the geometry of the machined surfaces and combined with the surface texture. The mechanism behind the formation of surface roughness is very complicated and process dependent. To select the cutting parameter properly,

Several mathematical models and based on statistical regression or neural network techniques have been constructed to establish the relationship between the cutting performance and cutting parameter. Then, an objective function with constraints is formulated to solve the optimal cutting 2 parameter using optimization techniques. Therefore, considerable knowledge and experience are required for this approach. In this study, an alternative approach based on the Taguchi method and is used to determine the desired cutting parameter more efficiency.

**Problem Statement:**

Turning is a widely used machining process in which a CNC machine turningcutting tool removes material from the surface of rotating cylindrical work piece. Three cutting parameters, i.e., feed rate, depth of cut, and Speed must be

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determined in a turning operation. A common method of evaluating machining performance in a turning operation is based on the surface roughness. Basically, surface roughness is strongly conelated with cutting parameters such as speed, feed rate, and depth of cut. Proper selection of the cutting parameters based on the parameter design of the Taguchi method is adopted in this paper to improve surface roughness in a turning operation.
Turning is one of the major machining processes which includes metal cutting as removal of metal chips in order to get finished product of desired shape, size and surface roughness.
The engineers have to face challenge in order to get optimal parameters for preferred output using available sources. Usually selection of machining parameters is very much difficult for desired product. Actually it depends upon experience of the engineers and the table given by machine-tool designer. So the importance of optimization arises in order to satisfy economy and quality of machined part. The Taguchi's method tells about reduction in variation in order to improve quality by method of offline or online quality control. The offline quality control helps in improving quality of processes, where online quality control helps in maintaining conformance to the original or intended design. The main and fundamental part of Taguchi's design is to ensure that the product perform well even in noise; it helps in making the product long lasting. Taguchi method is applied in a very short period of time without lots of efforts.

## II. LITERATURE SERVEY

Dr. Genichi Taguchi methods are a product of the Japanese post - World War era. When resources were scarce and financial support was at best minimal, the demands for reconstruction of Japanese industry were enormous. This period in Japanese history require accelerated learning and giant strides in improvement while being restrained by inferior raw material and lack of capital. From an engineering background, Dr Taguchi converted his study of statistics and advanced mathematics into a system merging statically techniques and engineering expertise (Glen Stuart, 1999).
Rajpoot used RSM to find the effect of cutting speed, feed and depth of cut on surface roughness and MRR while turning of AA6061. He does to find out the effect of every factor individually on surface roughness face centered design based on RSM. At three different points, the surface roughness is measured. In Design Expert 8.0.4.1 software, the results of 20 experimented samples were examined methodically to get the surface roughness & MRR. ANOVA was performed to analyze the regression model which was developed for evaluating surface roughness for an accuracy of 95%. Both surface roughness and MRR are found to be significant factors amongst the three cutting parameters.

BalaRaju studied the effect of cutting speed, feed and depth of cut while turning mild steel and aluminum by using HSS tool which was done to get better surface finish and to decrease power requirement. 2k factorial techniques were used to carry out the experiments. ANOVA was used to carry out the effect of cutting parameters and multiple regression analysis was used to develop cutting forces Feed was found to be significant factor effecting on both surface roughness and cutting force.

Hakim analyzed the effect of machining parameter on cutting force component in hard turning of AISI T15 high speed steel. The cutting force during the turning of the alloy steel was remarkably affected by the type of the chip produced.

Lawal evaluated the effect of cutting fluids on cutting force components in turning of AISI 4340 steel using Taguchi method. The results showed that cutting speed and cutting fluid were significant factors on cutting force measurements.

Lodhi experimented to optimize the surface roughness & material removal rate during machining of AISI 1018 alloy with Titanium coated carbide inserts. Spindle speed, feed rate & depth of cut were the input parameters. The experiment was performed in CNC Lathe machine using L9 orthogonal array. Surface roughness & material removal rate were obtained at the lowest and highest level respectively. ANOVA was used to obtain the most significantly effecting factor which was spindle speed for surface roughness & material removal rate with 75.295% & 78.173% respectively.

Mohan, examined the cutting speed, feed rate & depth of cut to get the minimum surface roughness. The work piece material used in the experiment was AISI 52100 steel alloy& cutting tool was Carbide inserts with nose radius 0.80. L9 orthogonal array was used for machining. Feed rate was found to be most significantly effected on surface roughness by ANOVA analysis.

## III. METHODOLOGY

Oxford dictionary define methodology as procedure or way of doing something. In spite of that, two main categories are made in this study method which is turning experiment and analysis of a result.
In the turning experiment we will focus on the cutting experiment from the start of the experiment till we got the surface finishes results. After we get for result, project will continue on analysis of the result to find an optimal cutting parameter

IJIREEICE

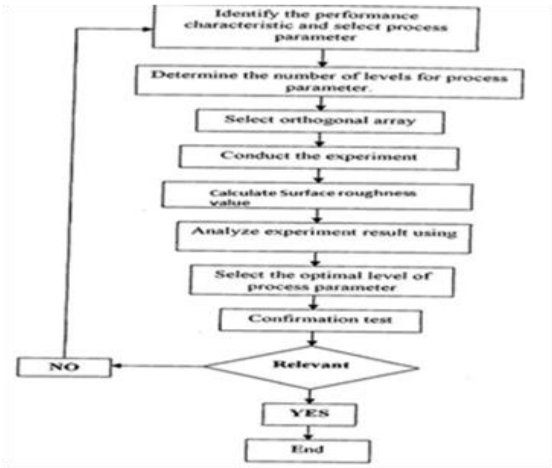
ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

Impact Factor 7.047 ⁜ Vol. 10, Issue 5, May 2022

DOI: 10.17148/IJIREEICE.2022.10508

for surface roughness. In the end of the project, confirmation test are used to verify the results. The flow chart been made to give us the guidelines and direction to rake the process successfully.




Flow Chart: Methodology

## IV. EXPERIMENTAL SETUP

**Cutting operation:**

Power hacksaws are used to cut 87mm of sizes (sections) of metals such as Mild steel1018. Cutting diameters of 30 mm is very hard work with a normal hand held hacksaw. Therefore power hacksaws have been developed to carry out the difficult and time consuming work. The heavy 'arm' moves backwards and forwards, cutting on the backwards stroke. The metal to be cut is held in a machine vice which is an integral part of the base. Turning the handle tightens or loosens the vice. The vice is very powerful and locks the metal in position.

Power hacksaws have electric motors that power the blade through a pulley system. Some have ratchet systems. The pulley system showed below shows how rotary power is transferred from the motor and changed to reciprocating motion; allow the blade to cut through the material.

Most power hacksaws have two pulley wheels. If the belt is placed on the smaller pulley wheel the speed of cut will be fast. Changing the belt so that it runs round the larger pulley wheel will reduce the speed.

**M.S bright steel aisi1018:**

Fig M.S bright steel aisi1018

**Specification of Power hacksaw Machine:**

All power hacksaw machines are basically similar in design. Figure shows a typical power hacksaw and identifies its main parts, which are discussed below.

Base : The base of the saw usually contains a coolant reservoir and a pump for conveying the coolant to the work. The reservoir contains baffles which cause the chips to settle to the bottom of the tank. A table which supports the vise and the metal being sawed is located on top of the base and is usually referred to as part of the base.

Materials commonly used in manufacturing power hacksaw blades are high-speed tungsten steel and high-speed molybdenum steel. On some blades only the teeth are hardened, leaving the body of the blade flexible. Other blades are hardened throughout.

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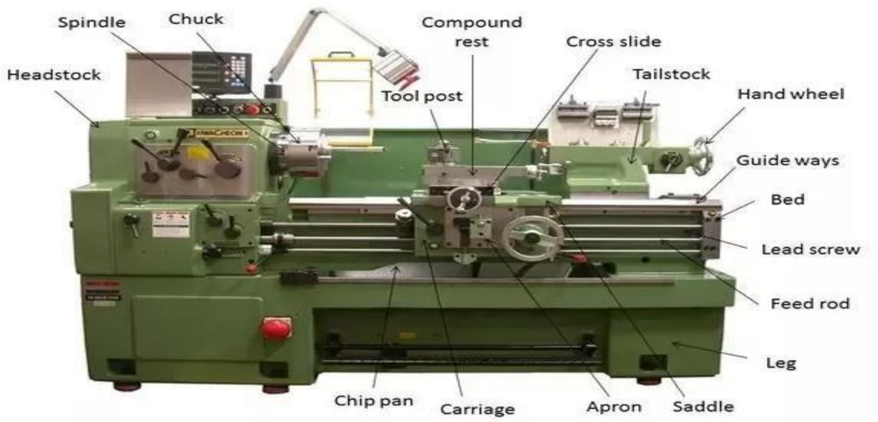
The set is the amount of bend given the teeth. The set makes it possible for a saw to cut a kerf or slot wider than the thickness of the band back (gage), thus providing side clearance.
This is the pattern in which the teeth are set. There are three set patterns: raker, wave, and straight, as shown in Figure.
The pitch of hacksaw blade teeth is expressed as the number of teeth per linear inch of blade. For example, saw blade.

Fig. Power hacksaw Machine

**Specification of lath machine:**




**Specification of cnc lath machine:**

Fig. CNC Machine

IJIREEICE
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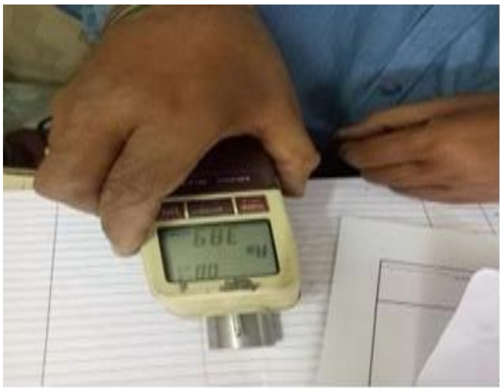
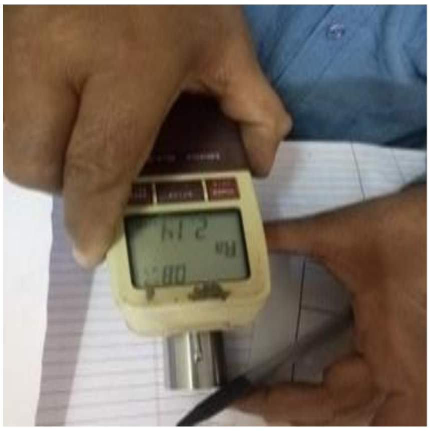
## V. DESIGN & IMPLIMENTATION

**Surface roughness measurement images:**





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**Surface roughness measurement:**

There are many different roughness parameters in use, but is by far the most common, though this is often for historical reasons and not for particular merit, as the early roughness meters could only measure common parameters include and Some Other parameters are used only in certain industries or within certain countries. For example, the family of parameters is used mainly for cylinder bore linings, and the Motif parameters are used primarily in the French automotive industry. The MOTIF method provides a graphical evaluation of a surface profile without filtering waviness from roughness. A motif consists of the portion of a profile between two peaks and the final combinations of these motifs eliminate ″insignificant″ peaks and retains ″significant″ ones. Please note that is a dimensional unit that can be micrometer or micro inch.

**Specification of Surface roughness testing instrument :**

1. The 2.4-inch colour graphic LCD provides excellent readability and an intuitive display that is easy to negotiate. The LCD also includes a backlight for improved visibility in dark environments.
2. The Surf test SJ-210 can be operated easily using the buttons on the front of the unit and under the sliding cover.
3. Up to 10 measurement conditions and one measured profile can be stored in the internal memory.
4. An optional memory card can be used as an extended memory to store large quantities of measured profiles and conditions.
5. Access to each feature can be password-protected, which prevents unintended operations and allows you to protect your settings.
6. The display interface supports 16 languages, which can be freely switched.
7. An alarm warns you when the cumulative measurement distance exceeds a present limit. The Surf test SJ-210 complies with the following standards: JIS (JIS-B0601-2001, JISB06011994, JIS B0601-1982), VDA, ISO- 1997, and ANSI.

In addition to calculation results, the Surf test SJ-210 can display sectional calculation results and assessed profiles, load curves, and amplitude distribution curves.

## VI. RESULT

1. The optimum that is minimum Ra value is found for speed =200rpm, feed=0.3mm/rev and depth of cut = 0.4mm and its value is Ra=1.37(μm).
2. Minitab 14 software is used for obtaining L16 orthogonal array
3. Orthogonal array has significantly reduced number of experiment to be conducted 4.It is found that speed and feed are more influencing factor for Ra than depth of cut
4. Machining time is also considered while machining the components.

## VII. CONCLUSION

This paper has presented an application of the parameter design of the Taguchi method in the optimization of turning operations. The following Conclusion can be drawn based on the experimental result of this study. Taguchi robust orthogonal array design method suitable to analyze the surface roughness (metal cutting). Problem as described in this study. It is found that the parameter design of the taguchi method provides simple Systematic and efficient methodology for the optimization of the machining parameters .The experimental result show that a and feed rate are the main parameter Among the three controllable factors speed, feed, depth of cut that influence surface roughness in turning AISI 1018 steel . In turning for minimum surface roughness use of lower feed rate medium depth of cut are recommended to obtain better surface roughness for the specific test range thus the surface finish is better.

Minimum surface roughness at optimum cutting parameter is 1.37 μm this research Demonstrates how to use taguchi parameter design for optimizationing machining Performance with minimum cost and time to industrial readers

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