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Taguchi Method for Analysing the Lathe Machine

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Abstract: ***The aim of the study of this method in Taguchi is to analyst a lathe machine operation while turning by some given parameter. The parameter on which we will study is speed, feed, depth of cut, MRR, cutting force, feed force, thrust force. We will use the Taguchi method to measure this type of parameter. Orthogonal arrays of Taguchi, the analysis of variance (ANOVA) will help to measure the effect and error Confirmation tests with the optimal levels of cutting parameters are administered so, for instance, the effectiveness of Taguchi optimization method. It is thus shown that the Taguchi method is extremely suitable to solve the problem.***
Keywords: Taguchi method, ANOVA, speed, analysing

I. INTRODUCTION

This paper is based on the Taguchi method as we all know that the method is used to improve the engineering in the company and it basic use in quality control of the machine in this paper we will going to study about the lathe machine but by using Taguchi which help us to define the problem of the machine which we are using in this process. As we all know that lathe machine conventional machines which manual use due to it takes time and also a human force because on one machine only one worker will work. Due to this cost of job(workpiece) increase and quality of job can have many human errors which are not good for one company. In this modern era of machines and industry, we need a modern solution that can help users to improve the quality and productivity of the company. The main challenge of the industry is high quality, dimensional accuracy, surface finish, high production rate, less wear on the cutting tools, cost-saving, and time-saving process, and reducing the production working impact.

A. Materials And Methods

Material: In this process of analysing the lathe match of Taguchi, we will use high-speed steel. The workpiece is 1.74kg and from a circle bar, its diameter is 42.6mm.

High-speed steel composition (table:1)

Sr no	Material	Percentage(%)
1	chromium	4%
2	tungsten	6% approx.
3	vanadium	2% around
4	molybdenum	(up to 10%)
5	cobalt	up to 9%
6	carbon	1%

In this process, we will use Minitab 19 which basic use for analysis a data in this software there one confirmation know as Taguchi which very uses full for this process our basic parameter will be speed (RPM), feed (mm), and depth of cut (mm) which will help us to find the error and effects of the machine in the form of a chart. In the process we will use a turning method on a lathe machine in which the workpiece (HSS) rotates in a single direction cut by cutting a sharp tool around its axis it has many features of cutting like boring, drilling, facing, threading, tapping, and etc. In this process, we are using a mild steel cutting tool because its cost is low then another tool. In the experiment which we will take place in the software of Minitab 19, we will use the L9 orthogonal array of the Taguchi Approach.

II. PROBLEM DEFINITION

In the experiment we are performing turning operations on the workpiece which is in a circle shape bar as we all know that every material has a rough surface which we clear while the operation has a good job .This process is very time consuming, therefore, the machine will optimization on given parameter like speed (RPM), feed (mm), and depth of cut (mm).on these 3 Parmenter, we will try to find the error by using ANOVA

A. Objective

As we are focusing on 3 input like Speed, Feed, and depth of cut to find the error of MRR(Kg/min), cutting force(N)Feed force(N), Thrust force(N)

To study the influence of lathe machines on HHS.

Study the Taguchi method

To find MRR(Kg/min), cutting force(N)Feed force(N), Thrust force(N)

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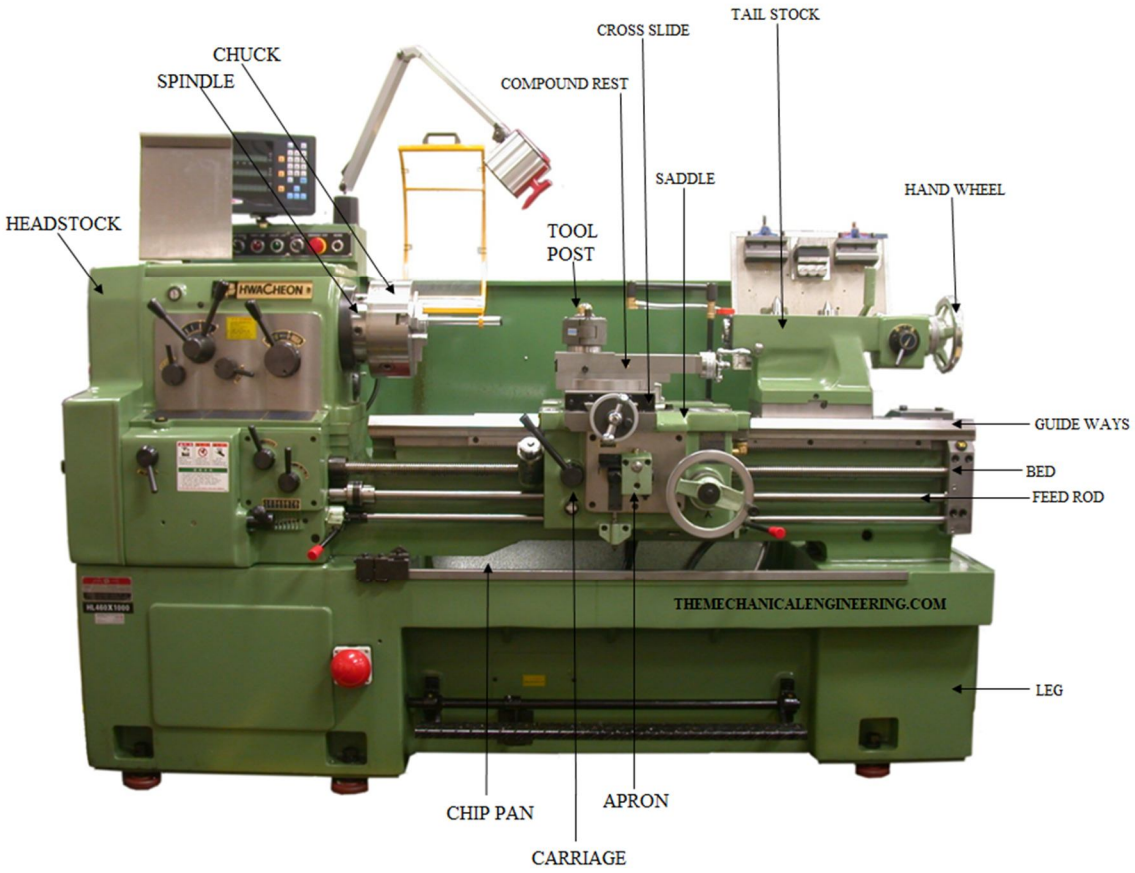
B. Experiment Setup

1) In the experiment we will be going to use a lathe machine which getting power for the motor



Length	150mm
Diameter	42.6mm.
Weight	1.74kg

Table:2

2) In this experiment we will put a workpiece in the chuck

3) Apply a water +oil coolant on the workpiece will operation if it needed

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C. Parameter

Speed(rpm)	Feed(mm)	DOC (mm)
880	11.1	0.4
880	18.1	0.9
880	25.7	1.5
1110	11.1	0.9
1110	18.1	1.5
1110	25.7	0.4
1500	11.1	1.5
1500	18.1	0.4
1500	25.7	0.9

Table: 3

III.RESULT AND CALCULATION FOR HIGH-SPEED STEEL

To measure the workpiece, we are using a vernier calliper. To measure the speed, we will use a Speedometer we take 9 readings and then apply the Taguchi method on it.

Design Summary

Taguchi Array	L9(3^3)
Factors:	3
Runs:	9

Columns of L9(3^4) array: 1 2 3

Taguchi design result

Speed(rpm)	Feed(mm)	DOC(mm)	MRR(Kg/ min)	cutting force(N)	Feed force(N)	Thrust force(N)	SNRA1	STDE1	MEAN1
880	11.1	0.4	0.006	3	5	1	-9.4201	2.2153	2.2515
880	18.1	0.9	0.012	3	7	0	-11.6137	3.3136	2.503
880	25.7	1.5	0.017	6	17	1	-19.1116	7.7845	6.0042
1110	11.1	0.9	0.009	3	8	1	-12.6717	3.5565	3.0023
1110	18.1	1.5	0.018	3	8	2	-12.8443	3.3977	3.2545
1110	25.7	0.4	0.027	7	12	2	-16.9241	5.3686	5.2568
1500	11.1	1.5	0.013	6	38	7	-25.8235	17.1116	12.7532
1500	18.1	0.4	0.026	8	20	0	-20.6446	9.4452	7.0065
1500	25.7	0.9	0.049	16	32	2	-25.0651	14.8074	12.5122

Table:4

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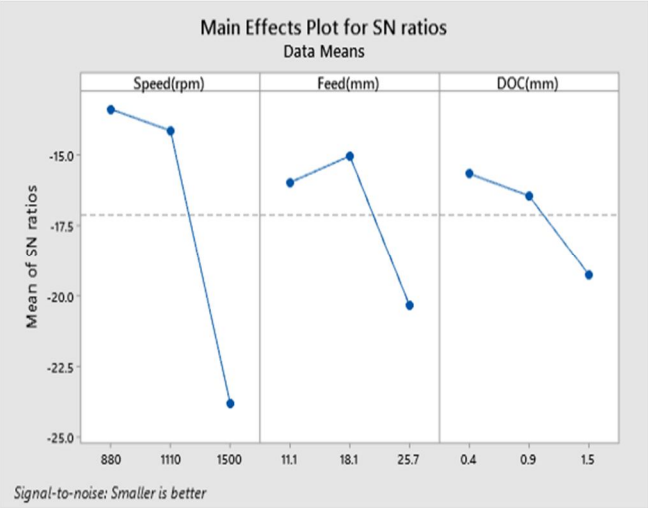
A. Result 1 of Taguchi design



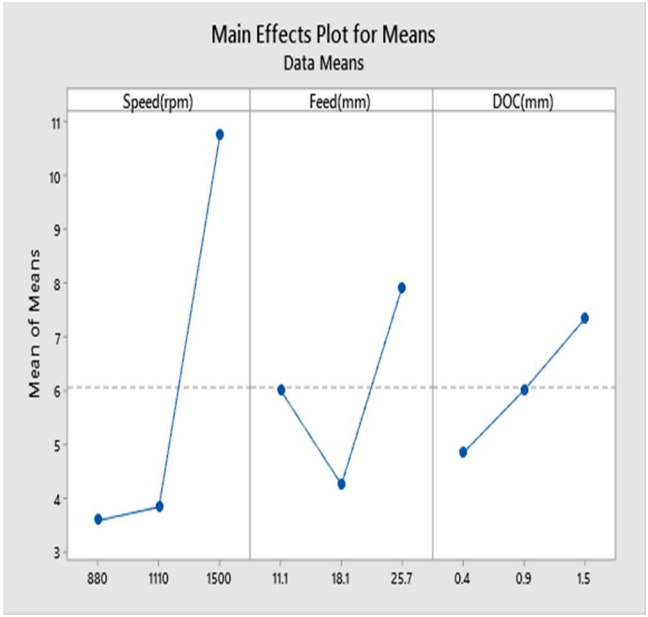
Response Table for Signal to Noise Ratios

Smaller is better

Level	Speed(rpm)	Feed(mm)	DOC(mm)
1	-13.38	-15.97	-15.66
2	-14.15	-15.03	-16.45
3	-23.84	-20.37	-19.26
Delta	10.46	5.33	3.60
Rank	1	2	3

Response Table for Standard Deviations

Level	Speed(rpm)	Feed(mm)	DOC(mm)
1	4.438	7.628	5.676
2	4.108	5.386	7.226
3	13.788	9.320	9.431
Delta	9.680	3.935	3.755
Rank	1	2	3



Response Table for Means

Level	Speed(rpm)	Feed(mm)	DOC(mm)
1	3.586	6.002	4.838
2	3.838	4.255	6.006
3	10.757	7.924	7.337
Delta	7.171	3.670	2.499
Rank	1	2	3

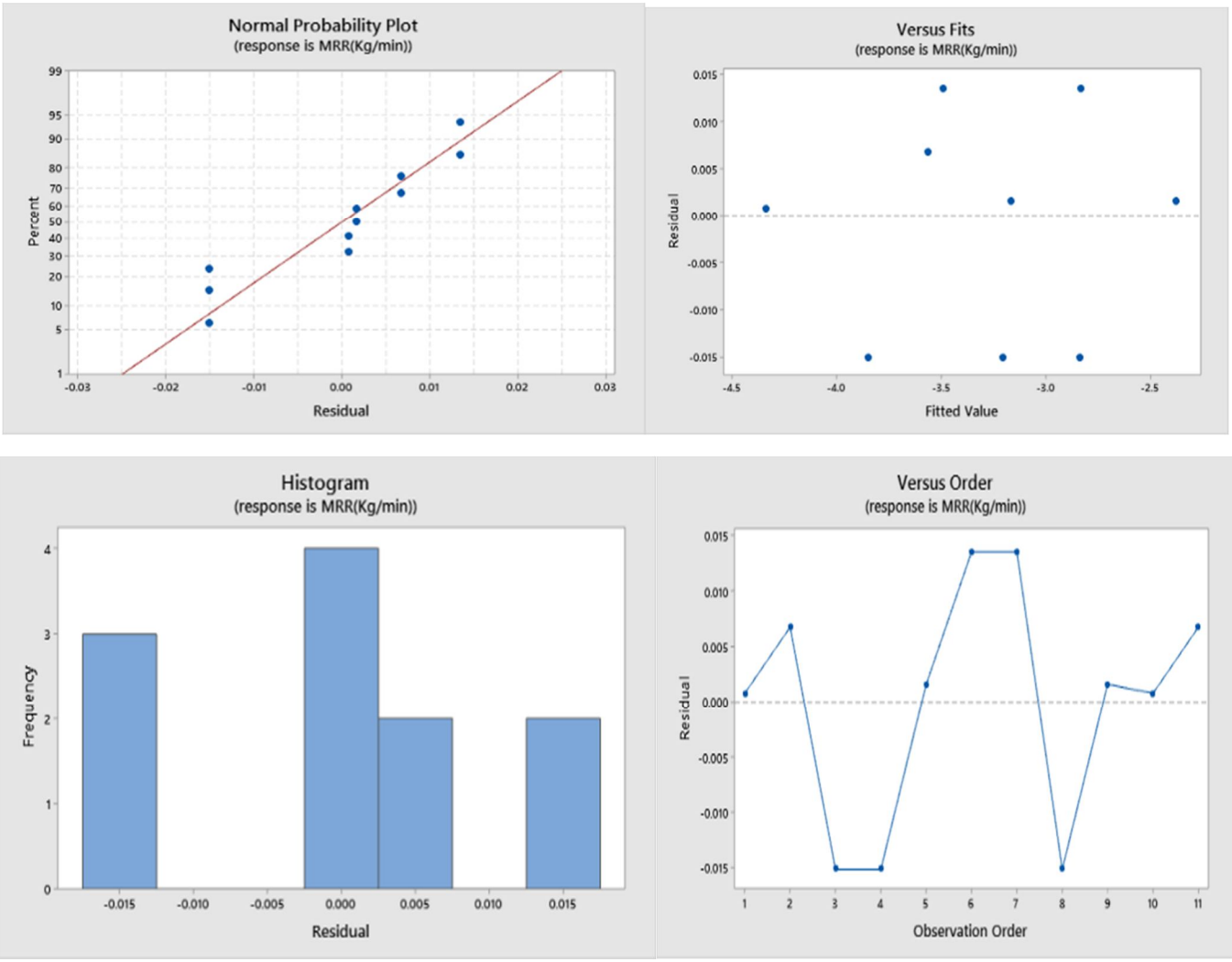
B. Analysis of Variance

Speed(rpm)	Feed(mm)	DOC(mm)	MRR(Kg/min)	cutting force(N)	Feed force(N)	Thrust force(N)	RESI	RESI_1	RESI_2	RESI_3	SRES	SRES_1	SRES_2	SRES_3
880	11.1	0.4	0.006	3	5	1	0.0008082	-0.0001029	-0.150931		0.06338	-0.0514	-0.57763	
880	18.1	0.9	0.012	3	7	0	0.0067626	-0.001077	0.159653		0.53036	-0.53775	0.61101	
880	25.7	1.5	0.017	6	17	1	-0.0151416	0.0023598	-0.017445		-1.83964	1.82541	-0.10343	
1110	11.1	0.9	0.009	3	8	1	-0.0151416	0.0023598	-0.017445		-1.83964	1.82541	-0.10343	
1110	18.1	1.5	0.018	3	8	2	0.0016164	-0.0002059	-0.301861		0.18725	-0.15184	-1.70644	
1110	25.7	0.4	0.027	7	12	2	0.0135252	-0.002154	0.319306		1.56678	-1.58862	1.80505	
1500	11.1	1.5	0.013	6	38	7	0.0135252	-0.002154	0.319306		1.56678	-1.58862	1.80505	
1500	18.1	0.4	0.026	8	20	0	-0.0151416	0.0023598	-0.017445		-1.83964	1.82541	-0.10343	
1500	25.7	0.9	0.049	16	32	2	0.0016164	-0.0002059	-0.301861		0.18725	-0.15184	-1.70644	
880	11.1	0.4	0.006	3	5	1	0.0008082	-0.0001029	-0.150931		0.06338	-0.0514	-0.57763	
880	18.1	0.9	0.012	3	7	0	0.0067626	-0.001077	0.159653		0.53036	-0.53775	0.61101	

Table:5 Analysis of Variance

1) Analysis of Variance for Transformed Response(General Linear Model: MRR(Kg/min) versus Speed(rpm), Feed(mm), DOC(mm))

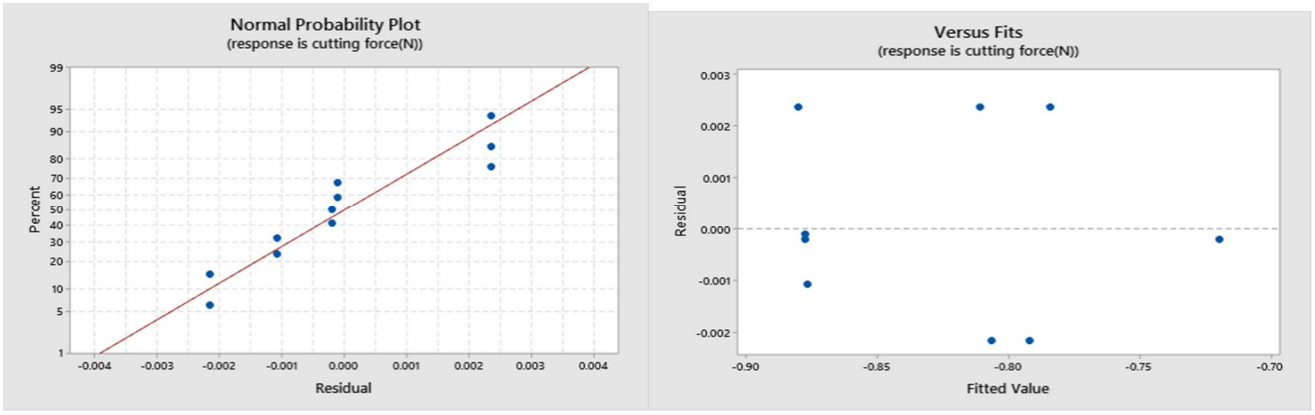
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Speed(rpm)	2	1.19642	0.59821	2077.73	0
Feed(mm)	2	2.08277	1.04139	3617	0
DOC(mm)	2	0.01021	0.0051	17.73	0.01
Error	4	0.00115	0.00029		
Lack-of-Fit	2	0.00115	0.00058	*	*
Pure Error	2	0	0		
Total	10	3.8131			



2) Analysis of Variance for Transformed Response

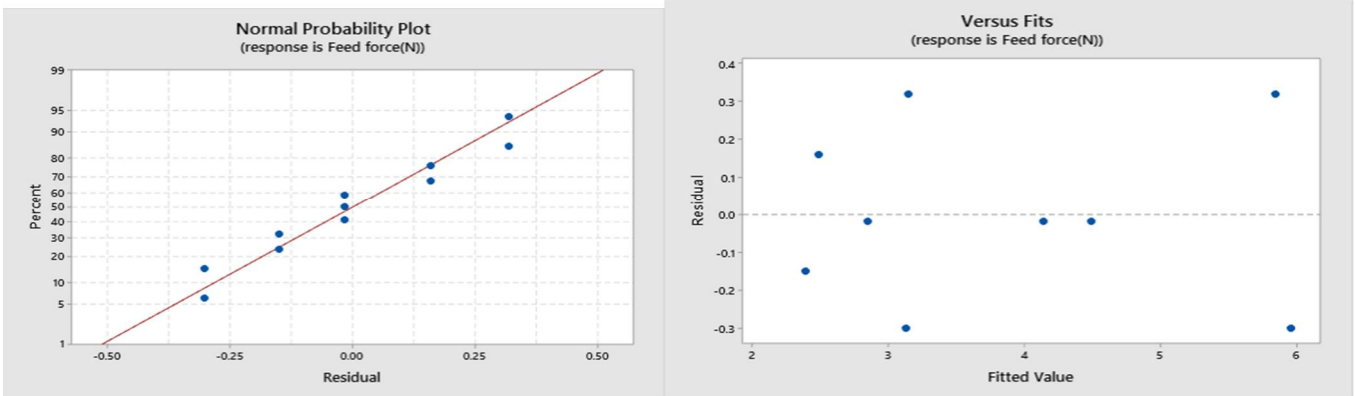
General Linear Model: cutting force(N) versus Speed(rpm), Feed(mm), DOC(mm)

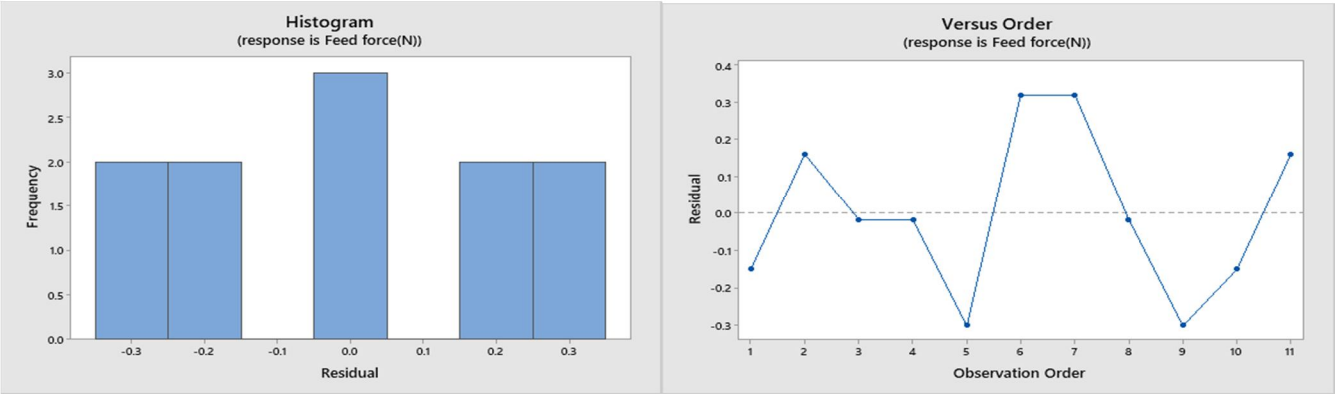
Source	DF	Adj SS	Adj MS	F-Value	P-Value
Speed(rpm)	2	0.014916	0.007458	1050.03	0
Feed(mm)	2	0.012507	0.006254	880.43	0
DOC(mm)	2	0.000325	0.000163	22.89	0.006
Error	4	0.000028	0.000007		
Lack-of-Fit	2	0.000028	0.000014	*	*
Pure Error	2	0	0		
Total	10	0.030193			



3) Analysis of Variance for Transformed Response (General Linear Model: Feed force(N) versus Speed(rpm), Feed(mm), DOC (mm))

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Speed(rpm)	2	12.5384	6.2692	51.85	0.001
Feed(mm)	2	1.8575	0.92877	7.68	0.043
DOC(mm)	2	1.7644	0.8822	7.3	0.046
Error	4	0.4836	0.1209		
Lack-of-Fit	2	0.4836	0.2418	*	*
Pure Error	2	0	0		
Total	10	18.5839			





IV. CONCLUSIONS

It is found that the relation between RPM and MRR, cutting force, Feed force

A. Regression Equation

MRR(Kg/min) ^-0.28694
=-3.29579 - 0.40748 Speed(rpm)_880 + 0.01255 Speed(rpm)_1110
+ 0.39494 Speed(rpm)_1500 - 0.59764 Feed(mm)_11.1
+ 0.10661 Feed(mm)_18.1 + 0.49103 Feed(mm)_25.7 - 0.04038 DOC(mm)_0.4
+ 0.03226 DOC (mm)_0.9 + 0.00812 DOC (mm)_1.5

B. Regression Equation

cutting force(N)^-0.118481
=-0.825131 - 0.03014 Speed(rpm)_880 - 0.02487 Speed(rpm)_1110
+ 0.05501 Speed(rpm)_1500 - 0.02978 Feed(mm)_11.1
- 0.02107 Feed(mm)_18.1 + 0.05085 Feed(mm)_25.7
+ 0.00720 DOC (mm)_0.4 - 0.00053 DOC (mm)_0.9
- 0.00667 DOC (mm)_1.5

C. Regression Equation

Feed force(N)^0.5
=3.825 - 0.821 Speed(rpm)_880 - 0.785 Speed(rpm)_1110
+ 1.606 Speed(rpm)_1500 - 0.133 Feed(mm)_11.1 - 0.457 Feed(mm)_18.1
+ 0.589 Feed(mm)_25.7 - 0.485 DOC (mm)_0.4 - 0.062 DOC (mm)_0.9
+ 0.547 DOC (mm)_1.5

This paper is made of a study of the given parameter of the lathe machine by using the Taguchi method. It found that the parameter design of the Taguchi method provides a simple, efficient methodology for analysing the process

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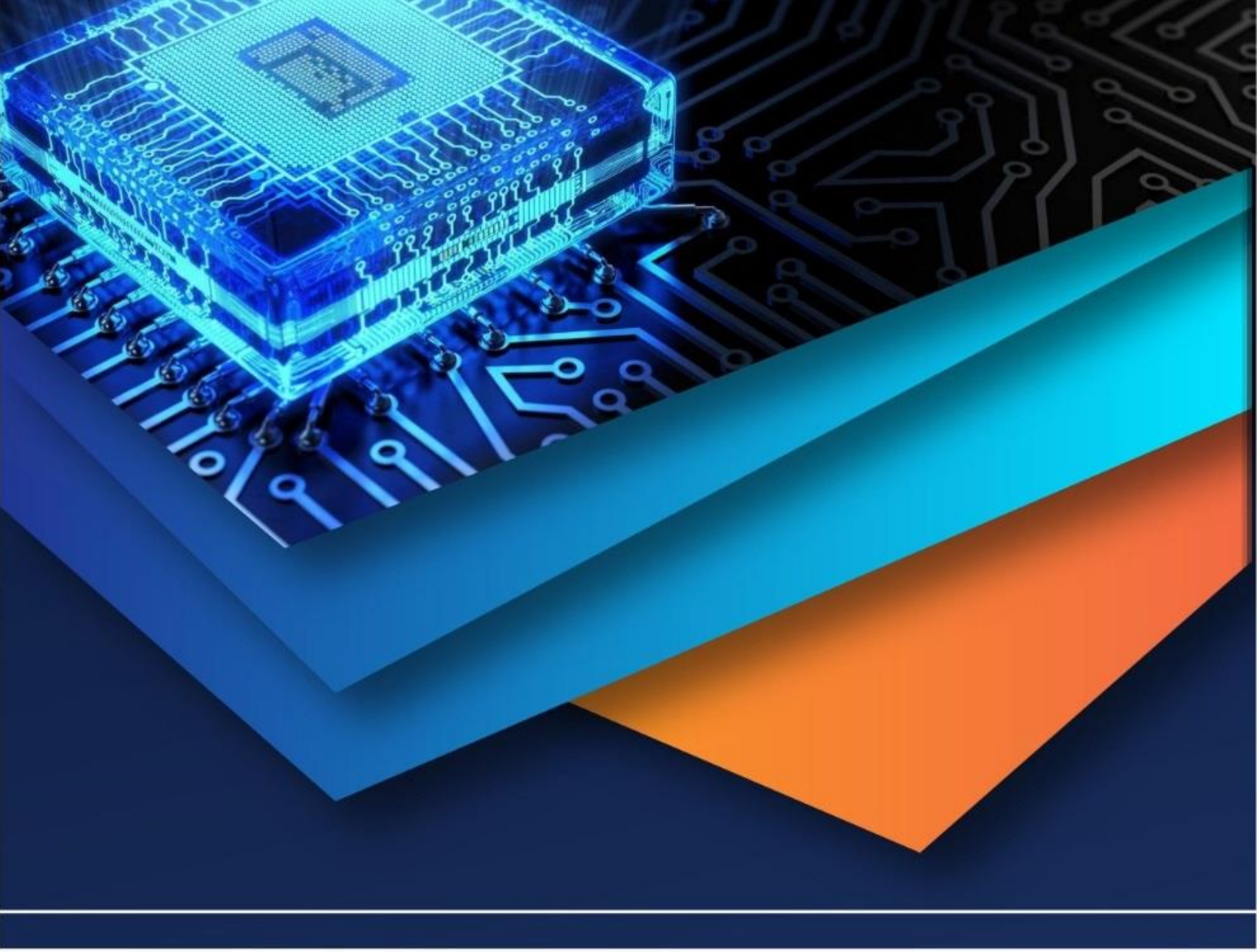

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