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Application of Taguchi to Cutting Behavior of Stainless Steels

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Abstract: The selection of un-appropriate cutting factors in any type of metal cutting is led to higher surface roughness and larger cost because they directly affect the quality characteristics and production rate. The cutting of AISI 304 stainless steel is investigated both experimentally and theoretically at basic parameters while outputs are surface roughnesses of Ra, Rz and Rt. Taguchi L9 design is adopted in analyzing the machining results using carbide inserts. Variance analysis and regression analysis are carried out to determine effective factors and relationship between the input and responses, respectively. It is shown that the optimum surface roughness is obtained around 1.18 µm, and the optimum parameters are determined from experiment trial 7. Further, the feed rate is dominant effect on the surface roughness while the speed and the depth of cut are not effective. Moreover, the regression models are developed, the correlation coefficients of Ra, Rz and Rt are found to be around 99.15%, 99.76% and 96.77%, respectively, that are quite reasonable, but slightly more errors generated in Rt results. The present finding results exhibit that Taguchi method is an effective method for improving surface quality of cutting stainless steels. The experimental design applied to improve surface quality is also applicable to industrial practices.

Keywords: AISI 304 stainless steel, Cutting parameters, Surface roughness

Introduction

Surface roughness (SR) is very important output because of affecting the directly product's quality besides fatigue/fracture strength of component surfaces. There are various manufacturing processes used in machining the mechanical parts such as turning shaping/planning, pressing, milling, drilling, grinding or less common non-traditional process such as mechanical, thermal and electro-chemical, like water jet machining, electro discharge machining, and chemical etching. The first group is called traditional machining, which is based on removal of materials using tools that are harder than the materials (Şahin, 2003). These are not efficient in machining ceramics and composites or very tight tolerances. The second group is preferred in avoiding surface damage that often accompanies the stresses created by traditional cutting, but these are slow processes to complete the jobs. Among these groups, however, turning is mostly used with appropriate cutting inserts because of being faster one. Dimensional accuracy plays a crucial role in today's manufacturing integrity, especially in aerospace, automotive, biomedical implants, and robotics. For this reason, SR not only affects how the parts looks like, but also has big effect on mechanical performance like wear, friction, fatigue rand fracture. In recently, many researchers have, therefore, focused more and more on advanced optimization methodologies that combine experimental design methods, computational modeling, and real-time process monitoring to get consistent and reproducible SR results. This approach also leads to brings together scientists from materials science, tribology, mechanical engineering and physics.

The ten-point mean roughness (Rz) number, maximum height (Rt), and arithmetical mean roughness (Ra) are the most common parameters to measure surface roughness. Ra, which is measured in µm, is the average

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distance between mean line and surface profile. Rz is the distance from mean line, concentrating on the highest peak and valley. Rt is the distance between the highest peak and the lowest peak in vertical direction. Surface control is very crucial in any metal cutting in terms of its function and longer service life. Mechanical properties like material strength and hardness affect the cutting force and surface roughness. The heat generated during the turning can cause thermal damage to the tool edge, causing early failure. Because of lower conductivity during machining AISI 304 steels, heat cannot transfer efficiently in separated chip (Kónya et al. 2024). Also, this steel may be hardened by itself during cut because it has got some alloy elements like Cr and Ni.

Many researchers examined at SR, tool life, and power of AISI 304 steels when cutting in different situations using Taguchi/RSM or Grey relation. Nehri et al. (2024) used the Taguchi approach, RSM, and ANN to study the turning of AISI 304L in order to predict wear and surface. AlO_3 plus TiCN-coated tool worked well. The results were proven to be dependable and correct through experimentation. Using Taguchi L9 design, Grey Relation Analysis, and PCA, Rathod et al. (2022) searched at tool life and surface roughness in turning same steels at higher speeds. The results indicated that speed was considerable influence for manufacturing time but depth of cut was effective for roughness. The higher speed associated with lower feed rate and depth of cut were best settings for surface roughness. Kumar et al. (2020) optimized the main cutting parameters in dry turning of AISI 304 steel using Taguchi (L9) and ANOVA to maximize metal removal rate (MRR). Feed rate was the most significant factor on MRR, followed by depth of cut and speed. Boucherit et al. (2024) applied Taguchi method and modified WPCA model to cut AISI 304 with coated carbide inserts including main parameters and nose radius. The results exhibited that contributions of feed rate and nose radius to surface roughness was about 52.4% and 26.5 %, respectively.

Su et al. (2020) presented a multi-objective optimization method of cutting parameters based on grey relational analysis (GRA) and RSM in turning AISI 304 austenitic steel. The multi-objective problem was converted into simple objective optimization problem through GRA. Optimal parameters were achieved at higher depth, lower feed rate and speed. Berkani et al. (2015) studied the empirical equations in characterizing machinability with RSM. The feed rate was the most effective, but the depth of cut affects cutting force and cutting power considerably. Binali et al. (2023) studied the turning of AISI 304 at dry and minimum quantity lubrication (MQL) environment conditions by TiC-coated insert using factorial design. The high speed resulted in 10% lower in surface roughness. Also, force decreased by 20% at low feed rate. The speed was observed as most influential factor on surface roughness, followed by feed rate. Other people study on MQL method with various oils (Binali et al. (2023) on sustainable approach; Dubey, Sharma & Singh (2021) on hybrid nano fluid MQL; Rajeswari R. (2024) on MQL with corn oil; and Singh, Dureja, Dogra & Bhatti (2018) on comprehensive MQL, Dry & Flood comparison. In addition, Nguyen et al. (2019) on green machining for the dry milling process of AISI 304, Hata, Widiatmoko, Mulyana & Azmy (2023) on wet milling optimization were studied. Nguyen et al.(2019) results revealed that the reductions in energy consumption and surface roughness were more or less 34.9 % and 57.7 %, respectively, while the improvements in power was around 28.8 % in comparison to initial factor. Hata et al. (2023) searched for the optimization of the machining parameter in wet milling process for AISI 304 and AISI 316 steels through the Taguchi method. The optimum surface roughness of AISI 304/316 stainless steel was around 0, 21-0, 24 μm, respectively. The depth of cut was the most influential parameter, but feed rate held pivotal factor on SR for AISI 316 steel. For other experimental and statistical study, Patel et al. (2015) studied the optimization and prediction of cutting force and surface roughness in end milling process of AISI 304 stainless steel. They employed Taguchi's L27 orthogonal array and regression analysis. Popan et al. (2015) also developed theoretical model using regression analysis that aimed to predict surface roughness in turning of AISI 304 stainless steel. The study analyzed the influence of basic factors on the quality. They focused on DoE methodology, specifically utilizing the Taguchi (L9) design, to explore the intricate relationships between inputs and Ra, Rt and Rz output. Taguchi technique was mostly used for process optimization and provided a structural approach to evaluate the influence of various factors using the limited numbers of tests (Sahin et al.2024). Furthermore, numerous studies investigated prediction studies on machining AISI 304 stainless steel on surface roughness, cutting forces and others based on machine learning, statistical methods and hybrid approaches. Zhou et al.(2019) on Gradient Boosting Regression Trees; Caydaş and Ekici (2012) on Support Vector Machines¸ Alajmi and Almeshal (2020) on ANFIS-QPSO and Popan et al.(2015) on Artificial Neural Network. These models showed high accuracy in predicting surface quality under different cutting conditions.

The literature survey indicates that there have been number of studies carried out on turning behavior AISI 304 stainless steels in optimizing surface roughness, material removal rate, cutting force or tool life (Adalarasan et al. 2015; Ramu et al. 2018; Elsiti and Elmunafi 2023; Sundara Bharathi et al. 2020) and application of methodology (Hamdan et al. 2012; Ramu et al.2018; Elsiti et al. 2023; Sundara Bharathi et al. 2020). However, a limited numbers of studies was conducted at machining of AISI 304 stainless steels using statistical method, focusing on surface roughness of Ra, Rt and Rz (Ozdemir 2019; Prakash et al. 2011, Alzyod, Konya and Ficzere, 2025, Rao Rh, Rao Jag and Suresh K, 2015). The purpose of current study is, thus, to determine the optimal parameters in turning AISI 304 steel under lower speeds but not only for Ra output, but also Rt, Rz values by carbide inserts. Moreover, regression models are developed for first order at 95% confidence level. Analysis of variance are carried out to determine the effective parameters on the response.

Materials and Methods

Austenitic stainless steel (AISI 304 steel) is mostly used in manufacturing, construction and aero plane industry because it is strong, resists corrosion, cheap, and flexible. Its mechanical and physical characteristics are listed in Table 1. Its machinability is the worst due to higher mechanical and lower conductivity. Thus, selection of the right cutting tool is vital important when turning AISI 304 steel. The tool utilized for present study is un-carbide insert (P10). In this work, SNMG 120408 tool signature is chosen.

Table 1. Mechanical and physical property of AISI 304 steel

Maximum tensile strength (MPa)	Yield strength (MPa)	Hardness (HB)	Elongation (%)	Modulus of elasticity (GPa)	Thermal conductivity (W/m/K)	Density (g/cm^3)
520-720	210	215	45	193	16.2	8.0

The experiment is conducted in Metal Cutting Laboratory of Mechanical Engineering Department of OSTİM TECH. Figure 1 indicates standard lathe machine with 2.5 kW power, which is utilized in machining trials. The dimensions of test specimens are 120 mm in diameter, 500 mm in length. To carry out set of nine experiments, the specimen is partitioned into nine uniform segments, each measuring 10 mm in length, separated by 4 mm in wide and 2 mm deep slit. A fresh cutting edge is utilized before starting each test. Each surface is measured using the Time 3200 surface roughness tester. Before starting the trials, the measurement device is calibrated to make sure the data is accurate.

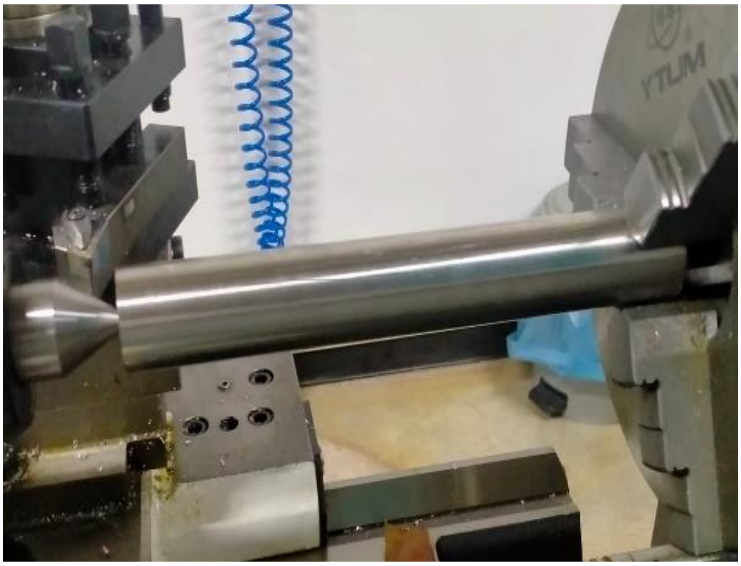


Figure 1. A standard lathe machine used for machining stainless steel through carbide insert

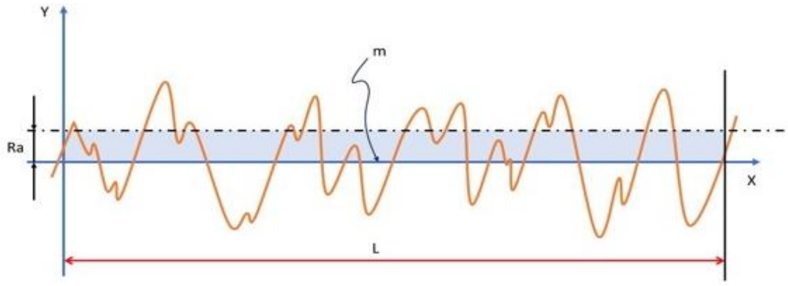
For this investigation, Taguchi L9 orthogonal array is chosen. Selected factors are spindle speed, feed rate, depth of cut. Each factor has three levels like low, medium and high. Table 2 shows the main factors and their levels for each parameter below. In addition, Time 3200 surface roughness tester is used in measuring SR of the tested steels to find out how to change the roughness values.

Table 2. Cutting parameters and their levels

Parameters	Level 1	Level 2	Level 3
Cutting speed (m/min)	50	79	113
Feed rate (mm/rev.)	0.08	0.11	0.18
Depth of cut (mm)	0.6	1.2	1.8

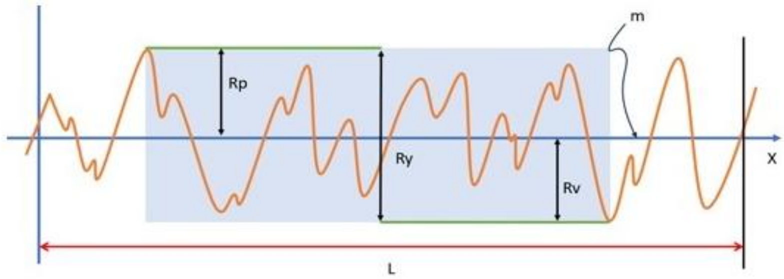
Surface Roughness Parameters

As shown in Figure 2, the industry uses some metrics for surface roughness's such as arithmetical mean roughness (Ra), maximum height (Rt), ten-point mean roughness (Rz) number. The mean line is in coordinate system (x, y) axes. The mean line goes along x-axis, while y-axis shows how much the mean line will be varied. We chose to test all three SR parameters—Ra, Rz, and Rt, rather than just Ra because we need to see both peaks and valley's changes in the shape of the machined surface. Ra gives a broad idea of average roughness, whereas Rz and Rt give more information about peak-to-valley characteristics or five to ten point measurements, as exhibited in Fig. 2 (b, c), which are very important for sealing surfaces, fatigue loading or coating adherence.



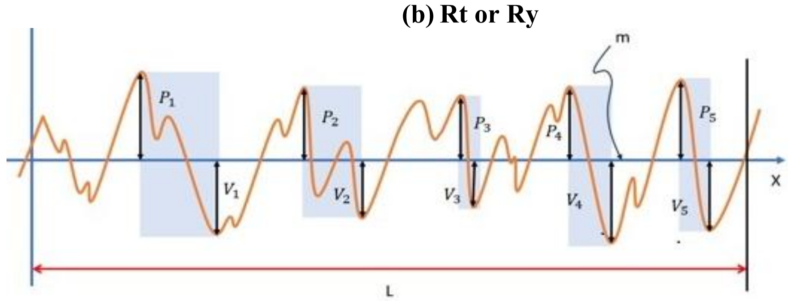
$$R_a = \frac{1}{L}\int_0^L |f(x)|dx$$

(a) Ra



$$R_y = R_p + R_v$$

(b) Rt or Ry



(c) Rz

$$R_z = \frac{|R_{p1} + R_{p2} + R_{p3} + R_{p4} + R_{p5}| + |R_{v1} + R_{v2} + R_{v3} + R_{v4} + R_{v5}|}{5}$$

Figure 2. Basic surface roughness parameters used for industry (P: Peaks while V: Valleys; Rp: Tallest 5 peaks within the measuring length; Yv: Lowest 5 peaks within the measurement length)

Results and Discussion

Surface Roughness of Ra

Figure 3 illustrates the primary effects plot of surface roughness represented by Ra values in turning, detailed in Table 3. The data in this figure reveals that feed rate is the most significant parameter, varying linearly with an increase in feed rate, followed by depth of cut while cutting speed is in-significant. The increased surface roughness values with increasing feed rate is attributed to the classical theory of metal machining (Sahin, 2003). Additionally, higher surface roughness produces when more friction takes place between the tool/specimen. Coated layer has not demonstrate an enhanced stability at these lower test environments. Comparable results are noted in the previous research works (Kumar, 2020; Boucherit et al. 2024; Berhani, 2015). However, another investigation showed that the speed is effective on machining AISI 304 steels (Binali 2023; Rathod 2022).

Table 3. Taguchi L9 design and its Ra value results

Trial number	V (m/min)	f (mm/rev)	t (mm)	Ra (µm)	FITS_MEANS1 (µm)
1	1	1	1	1.793	1.7561
2	1	2	2	2.767	2.6611
3	1	3	3	6.81	6.9527
4	2	2	3	1.211	1.3537
5	2	3	1	2.738	2.7011
6	2	1	2	7.61	7.5041
7	3	3	2	1.181	1.0751
8	3	1	3	2.791	2.9337
9	3	2	1	6.82	6.7831
		Average error (%)		1.48	

The lowest surface roughness is achieved with lower feed rate, higher speeds, and higher depth of cut when carbide tool is used. In other words, the optimum cutting parameter is determined from the first trial of experiment, yielding about 1.181 µm, which exhibits an excellent performance in relative to other experiments. Namely, the optimum cutting is achieved with carbide tool at V = 113 m/min, f = 0.08 mm/rev, t = 1.8 mm, which is followed by trial 7 (Figure 3). The cutting speed is an ineffective, can be disregarded. Hamdan et al. (2012) also reported that feed rate (80.85%) is the dominant parameter on SR, followed by speed (8.24%), depth of cut (7.59%), respectively. The optimal SR is achieved through the use of coated carbide in the optimization process.

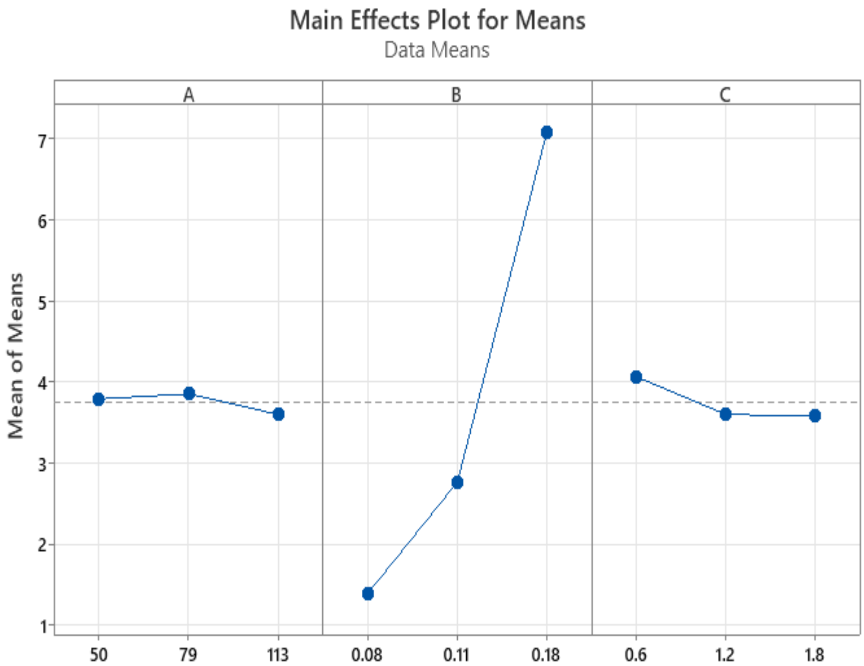


Figure 3. Main effect plots for SR of Ra in cutting the SS

Table 4 shows the results of response table for means Ra values. It is indicated that feed rate is the most significant factor on SR because it holds the topmost (rank 1), followed by depth of cut (rank 2), speed (rank 3), as observed by the slope of the line. This might be due to selecting the lower speed in the present study. The previous study indicates that feed rate is effective for SR while feed rate, depth of cut are significant on MRR for AISI 304 stainless steel (Şahin and Akbar, 2024). Among the tool tip used, sintered P10 carbide tool shows a slightly lower surface roughness about 1.297 µm, which is achieved from trial 1. For MRR, optimum levels are found at conditions of spindle speed of 1200 rpm, feed rate of 0.24 mm/rev., depth of cut of 1.5 mm when cut with or without any tool. AISI 304 stainless steels are machined at various cutting conditions using coated carbide inserts by the Taguchi approach (Şahin and Ogulmuş, 2024). The results exhibited that feed rate, speed are effective for SR, whereas feed rate and depth of cut were significant for MRR. TiCN coated carbide indicated the lowest SR indicating at 0.68 µm, which is corresponding to trial 7. The results revealed that the optimum SR was found at higher speed/depth of cut associated with lower feed rate.

Table 4. Response table for means

Level	A (Cutting speed)	B (Feed rate)	C (Depth of cut)
1	3.790	1.395	4.065
2	3.853	2.765	3.599
3	3.597	7.080	3.576
Delta	0.256	5.685	0.488
Rank	3	1	2

Regression Equation

Regression is used for studying SR when machining stainless steels.

Regression Equation,

$$Ra = -2.624 - 0.00319\ x\ A + 57.7\ x\ B - 0.407\ x\ C \quad (1)$$

Where Ra is SR index, A is speed, B is feed rate and C is depth. This equation shows that A and C coefficients are negative while B is positive. Its coefficients (R-Sq.) is found to be 99.15%. These results exhibit good accuracy for models with experimental value.

ANOVA

ANOVA is performed; the results are listed in Table 5. The feed rate factor is statistically significant at 5% significant level for because of (p=0.002) while other factors are not found an effective because p is higher than that of 0.05. Moreover, the contribution mostly comes from the feed rate, the error term is lower when turned these steels. The correlation coefficient, R-Sq is found to be 99.15%. Feed rate is the most effective factor, contributing 98.8% to the variation in surface roughness, depth of cut and speed can be neglected.

Table 5. Analysis of variance for means

Source	DF	Seq SS	Adj SS	Adj MS	F	P-value	Pcont,%
A	2	0.1065	0.1065	0.0532	1.08	0.482	0.19
B	2	52.8134	52.8134	26.4067	534.14	0.002	98.76
C	2	0.4555	0.4555	0.2278	4.61	0.178	0.85
Residual Error	2	0.0989	0.0989	0.0494			0.184
Total	8	53.4743					

Surface Roughness of Rz

Figure 4 illustrates the main effects plot of surface roughness of Rz values in turning, with corresponding results are presented in Table 6. The data in this figure, feed rate again is the most influential parameter, exhibiting a linear relationship with increasing feed rate, followed by speed and depth of cut. Ozdemir et al. (2019) found that the fundamental factors influencing surface roughness (Ra, Rz) are determined as feed rate, depth of cut, and cutting speed. The Box-Behnken Experimental Design utilized for Ra, Rz parameters in drilling of MDF composite panels indicated (Prakash et al. 2011) that the surface roughness of the predicted model during the confirmatory test exhibits of 2.06% and 2.631% error for Ra and Rz, respectively. A recent study conducted by Alzyod et al. (2025) indicated that feed rate was the dominant factor on surface roughness, contributing to Ra and Rz high levels. Metal removal rate was also effective for feed rate and depth of cut. Rao, Ch et al. (2015) conducted surface roughness analysis of Ra, Rq and Rz in cutting EN19 steel utilizing Grey relation analysis. The models created on roughness parameters demonstrated significant results because of yielding high coefficient correlation of 0.992, 0.987 and 0.982 for Ra, Rt and Rz, respectively.

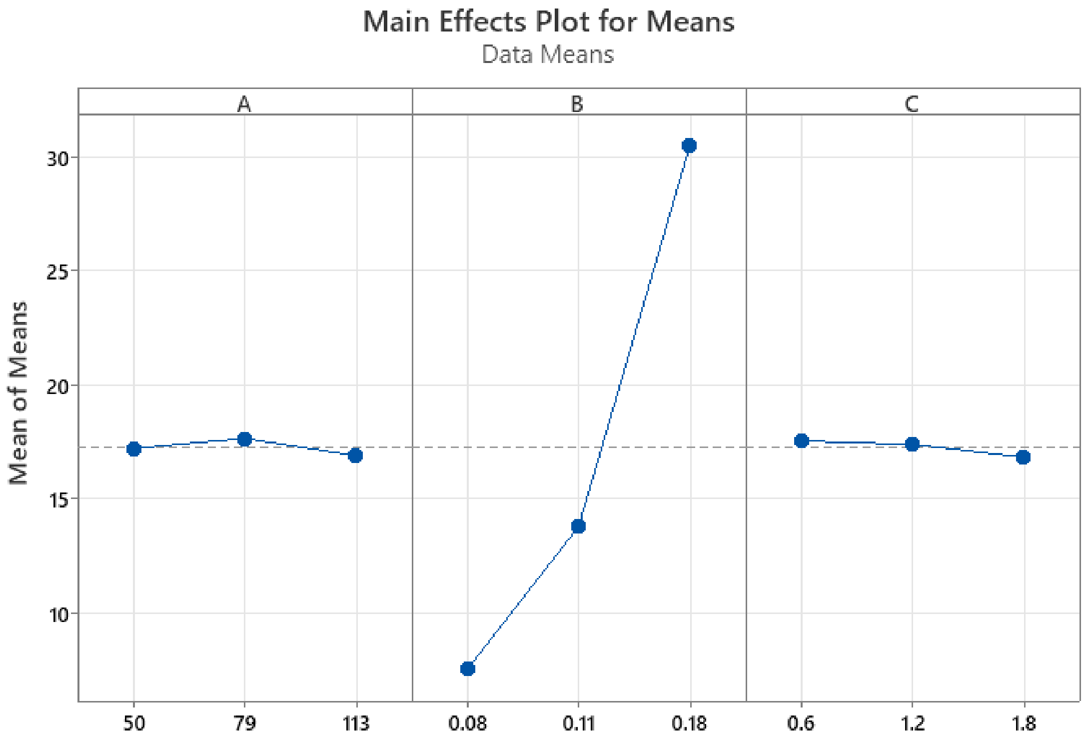


Figure 4. The main effect plots for SR of Rz in cutting the SS

Table 6. Taguchi L9 design and its Rz results

Trial number	V (m/min)	f (mm/rev)	t (mm)	Rz (µm)	FITS_MEANS2
1	1	1	1	8.064	7.7678
2	1	2	2	13.86	13.859
3	1	3	3	29.7	29.996
4	2	2	3	7.75	8.0468
5	2	3	1	14.04	13.7439
6	2	1	2	31.145	31.1442
7	3	3	2	6.738	6.737222
8	3	1	3	13.4	13.69689
9	3	2	1	30.525	30.22889

Table 7 shows the results of response table for means Rz values. The feed rate is the most significant factor on the SR because it holds the topmost (rank 1), followed by speed/depth of cut, but no considerable difference occurred between the depth of cut (rank 3=16.826) and speed (rank 2=16.888).

Table 7. Response table for means

Level	A (Speed)	B (Feed rate)	C (Depth of cut)
1	17.208	7.517	17.536
2	17.645	13.767	17.378
3	16.888	30.457	16.826
Delta	0.757	22.939	0.710
Rank	2	1	3

Regression Equation

Regression Equation is given the following equation.

$$Rz = -10.08 - 0.00557\ x\ A + 230.9\ x\ B - 0.592\ x\ C \quad (2)$$

Where Rz is SR index. Again, it shows that A, C coefficients are negative while B is positive. Their determination coefficient (R-Sq.), R-Sq. (adj), R-Sq. (pred) are found to be 99.76%, 99.610% and 99.10%, respectively. These results exhibit good accuracy for models with experimental value.

ANOVA

ANOVA analysis is performed; the results are given in Table 8. The feed rate again is statistically significant at 5% significant level for because of (p=0.001) while other factors are not found an effective. Moreover, the error term is also lower when turned these steels, and R-Sq is found to be 99.8%. The feed rate contribution reaches to 99.7% on roughness, whereas, depth of cut/speed can be disregarded due to it's contributing of 0.10% or lower.

Table 8. Analysis of variance for means

Source	DF	Seq SS	Adj SS	Adj MS	F	P-value	Pcont, %
A	2	0.867	0.867	0.434	1.64	0.378	0.1025
B	2	843.823	843.823	421.912	1599.74	0.001	99.736
C	2	0.835	0.835	0.417	1.58	0.387	0.098
Residual Error	2	0.527	0.527	0.264			0.067
Total	8	846.053					

Surface Roughness of Rt

Figure 5 illustrates the main effects plot of surface roughness of Rt values during turning, as summarized in Table 9. The data presented in this figure, feed rate is the most effective parameter, followed by speed/depth of cut. Speed appears to be more effective than that of depth of cut. However, both parameters demonstrate a decreasing trend when increasing speed and depth of cut. Rt exhibits slightly different behavior because of coming from its definition. This can be attributed to increasing the height difference between the highest mountain and the lowest valley in overall measurement distance. Srivabut et al. (2024) examined the optimization of turning process, focusing on fundamental parameters affecting the roughness quality of wood-plastic composites (WPCs) through the Box–Behnken design and response surface methodology (RSM). Optimal conditions for the turning were identified at a spindle speed of 781 rpm, a feed rate of 0.05 mm/min, and a depth of cut of 2.8 mm with 30 wt. % wood sawdust. Under these conditions, the samples indicated Ra*,* Rq*,* and R*z* values of 1.8, 2.2, and 11.3 μm, respectively.

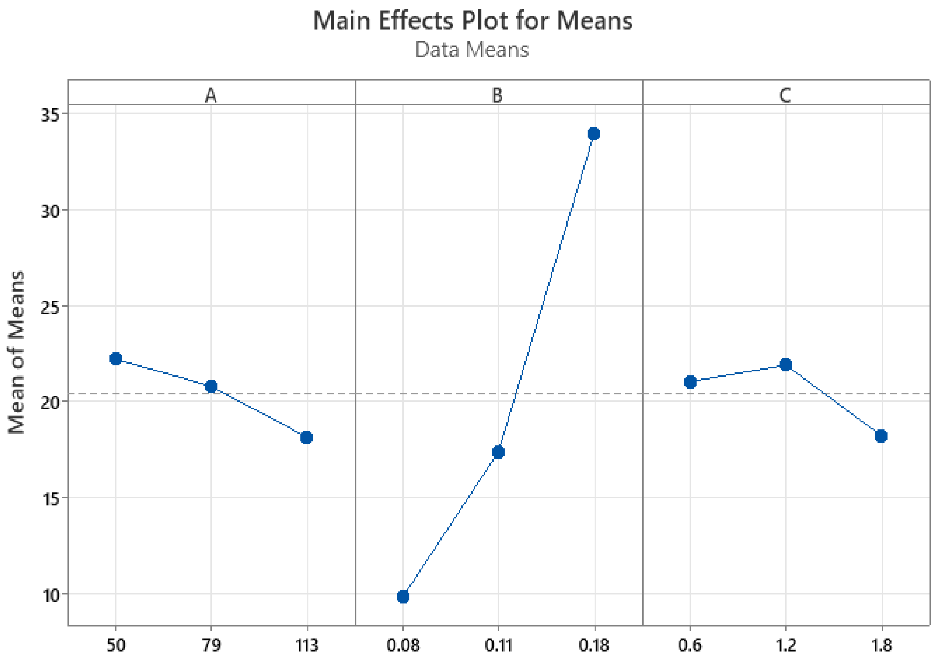


Figure 5. The main effect plots for SR of Rt in cutting the SS.

Table 9. Taguchi L9 design and its Rt results

Trial number	V (m/min)	F (mm/rev)	Depth of cut(mm)	Rt (µm)	FITS_MEANS3
1	1	1	1	12.291	12.288
2	1	2	2	22.615	20.7487
3	1	3	3	31.79	33.6574
4	2	2	3	9.869	11.7364
5	2	3	1	15.645	15.6437
6	2	1	2	36.915	35.0487
7	3	3	2	7.27	5.40377
8	3	1	3	13.94	15.8074
9	3	2	1	33.27	33.2687

Table 10 shows the results of response table for means Rt values. The feed rate is the significant effect on the SR because it holds the topmost (rank 1), followed by speed (rank 2) but again small differences appears between speed and depth of cut.

Table 10. Response table for means Rt values

Level	A	B	C
1	22.232	9.810	21.048
2	20.810	17.400	21.918
3	18.160	33.992	18.235
Delta	4.072	24.182	3.683
Rank	2	1	3

Regression Equation

Regression Equation is given the following equation.

$$Rt = -1.26 - 0.065\ x\ A + 241\ x\ B - 2.34\ x\ C \quad (3)$$

Where Rt is SR index. Again it shows that A, C coefficients are negative while B is positive. Its correlation coefficients (R-Sq.), R-Sq. (pred) are found to be 96.77% and 86.73%, respectively. The coefficients values are decreased significantly in comparison to Ra and Rz values. This can be because the vertical distance between the highest peak and lowest peak of roughness profile increased within the overall measurement length.

ANOVA

The results of variance analysis are given in Table 11. The feed rate factor is statistically significant at 5% significant level because of (p=0.000) while other factors are not found an effective because p=0.104 and p=0.231 for A and C, respectively. Moreover, R-Sq is found to be 99.1%. Similar findings are found, but slightly difference is evident because feed rate is the major factor, contributing 93% to the variation, speed has a contribution of 2.55% while depth of cut can be neglected.

Table 11. Analysis of variance

Source	DF	Adj SS	Adj MS	F-Value	P-value	Pcont. %
A	1	25.21	25.213	3.95	0.104	2.555
B	1	917.45	917.452	143.82	0.000	93.00
C	1	11.87	11.872	1.86	0.231	1.20
Error	5	31.90	6.379			3.2033
Total	8	986.43				

The existing literature survey proposes that the R-square should fall in the range from 0.8 to 1 (Chicco et al. 2021).

Confirmation Tests

The aim of confirmation test is to validate optimal testing parameters obtained from SR. The test is performed with two replicas. Predicted Ra, Rz and Rt using an optimal level is calculated from Equation (1, 2, 3),

$$Y_{pred.} = Y_m + \sum_{i=1}^{m} (Y_i - Y_m) \tag{4}$$

Where, Ym indicates total mean SR, Yi represents the mean SR at optimal condition, m is number of inputs, and its result is indicated in Table 12. Other study on the experiment is performed with the optimal level of the selected variables (V3-f1-d3) (Sahin & Öğulmus, 2024). It is reported that statistical analysis can only be deemed reliable if the error values remain below 20% (Columb & Atkinson, 2016).

Table 12. Confirmation tests with Taguchi/regression equation

	Taguchi method Eq.(1)			Regression Eq.(2)		
For Ra	Exp.(µm)	Pred.	Error (%)	Exp.(µm)	Pred.	Error (%)
A3B1C3 (Opt.)	1.15	1.07	8.9	1.15	0.899	27.9
A2B2C2 (Rand.)	2.78	2.467	4.45	2.78	2.88	3.47
For Rz	Exp.	Pred.	Error (%)	Exp.	Pred.	Error (%)
A3B1C3 (Opt.)	6.720	7.579	11.3	6.72	6.704	2.9
A2B2C2 (Rand.)	13.82	14.29	10.0	13.82	14.17	3.29
For Rt	Exp.	Pred.	Error (%)	Exp.	Pred.	Error (%)
A3B1C3 (Opt.)	6.91	5.405	27.8	6.91	6.463	6.9
A2B2C2 (Rand.)	22.60	20.748	8.96	22.60	19.18	17.83

Conclusions

The surface roughness's of Ra, Rz and Rt are developed when machining AISI 304 SS by Taguchi method. The results exhibited that the optimum surface roughness was found at cutting speed of 113 m/min, feed rate of 0.08 mm/rev, and depth of cut of 1.8 mm. At the same content, trial 7 yielded the lowest surface roughness approximately 1.18 µm, which was lower than that of the previous reported work. Further, ANOVA indicated that feed rate was a considerable influence on surface roughness with a 95% confidence level, while others were in-significant effect. Confirmation tests was conducted both Taguchi method and regression analysis. Moreover, correlation coefficients of Ra, Rz and Rt were found to be approximately 99.15%, 99.76, and 96.77%, respectively. The coefficient of Rt value was decreased slightly in comparison to Ra and Rz values. That is, Rt produced more errors but its result is within an acceptable range. These findings are significantly important for both academic researchers and the enhancement of mass production processes.

Scientific Ethics Declaration

*The authors declare that the scientific ethical and legal responsibility of this article published in EPSTEM journal belongs to the authors.

Conflict of Interest

*The author declares that there is no conflict of interest.

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